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**THANK YOU FOR YOUR PARTICIPATION!**



## INTRODUCTION

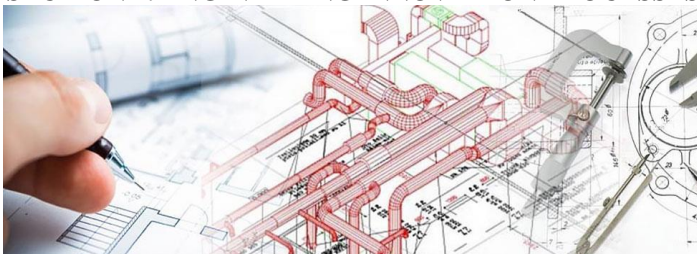
Over the last decades the overall impact of innovation on national welfare has changed considerably. Innovation practice today shows that innovation is by nature a term free of values and comprehensive covering the whole spectrum of activities from discovery to first time practical application of new knowledge of any kind. “A country that will not be able to be a creator of new innovative technologies is not simply doomed to a dependent position. The share of the global pie that get to its enterprises and the inhabitants of these countries will be much less than that of the leaders. Look, how income is distributed between those countries that produce an intellectual product and those that collect the final product. The ratio is 15 % and 80” said V.V. Putin to Federal Assembly.

The VII-th All-Russian Science-Practical Conference of Students, Postgraduates and Young Scientist “Recent Achievements and Prospects of Innovations and Technologies” is aimed at giving place of meeting for scientists of different universities, where they can represent their scientific achievements and discuss the matters of innovations. It will be a little part of the efforts at technological progress, at implementation of the innovative ideas into products and services, which create growth and working places for the constitution of one more just and fair society. Whether you are embarking on your research journey or aspiring to grow your achievements in science, technology and business, the Conference is your platform to grow and network with likeminded researches all over the world.

The famous Australian scientist, Doctor, Associate Professor Tim Crowe addressed to the participants of the conference:

“Greetings to all of you attending this wonderful conference with many fascinating topics that have so much to offer in helping improve the lives of people. The nature of your disciplines is one that requires an always questioning mind to ask the questions, seek the answers, and to communicate the relevance of this to the world. I wish you success not only today, but also in your future bright careers”.

## SECTION 1: ENGINEERING INNOVATION PROCESSES



UDC 62-4

### **SYNTHESIS AND ANALYSIS OF A DIRECTED RESPONSE IN A STRIP METAL DIELECTRIC WAVEGUIDE**

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**Introduction.** The results of experimental studies of a combined directional coupler are presented, the channels of which are made on heterogeneous waveguides: metal and flat metal-dielectric.

**The main part.** At present, a new type of structurally simple and economical microwave transmission line is developed - a strip metal-dielectric waveguide (SMDW) [1], which is an alternative to a standard hollow metal waveguide (HMW). The development of the element base on the basis of the SMDW requires the creation of measuring devices intended for experimental testing of the proposed waveguide nodes. At the first stage, while these nodes are absent, it is possible to use meters that combine in their structural schemes a combination of elements constructed both on the basis of a new type of waveguide and a standard one-hollow metal. A device combining these two types of elements can be a combined directional coupler, whose channels are made on heterogeneous waveguides. The channel, built on the basis of the HMW, includes the existing necessary measuring elements, and in the second - the investigated devices of the SMDW.

Figure 1 shows a schematic representation of a multi-hole combined directional coupler (CDC) [2, 3]. A feature of the CDC is that the

wavelengths in its waveguide channels are not the same. Therefore, the known methods for calculating multi-hole directed observer are not suitable for CDC. In standard directional couplers, the distance between the centers of the communication holes of the waveguide channels is equal to a quarter of the mean wavelength in the waveguide. In this case, the phase shift between the branched waves by two adjacent holes in the opposite arm of the directed observer is  $180^\circ$  and the waves are mutually compensated. In the direct arm of the wave, the branching of all communication holes is in phase, their amplitudes are summed.

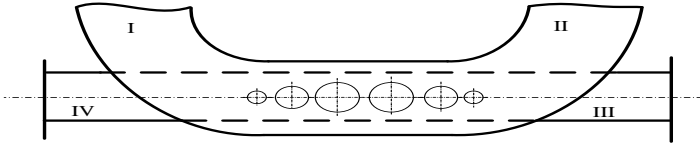


Figure 1 – Schematic representation of multi-hole combined directional coupler

Differences in wavelengths in the waveguide channels of the combined directional coupler and the associated difference in phase shifts of waves at equal distances in the channels should be taken into account in the synthesis and analysis of the CDC.

The CDC consists of two channels, one constructed on the basis of the PMV, and the second based on the SMDW. A feature of the CDC is that the wavelengths in its waveguide channels are not the same. Therefore, the known methods for calculating multi-hole directed observer are not suitable for CDC [4]. In standard directional couplers, the distance between the centers of the communication holes of the waveguide channels is equal to a quarter of the mean wavelength in the waveguide. Differences in the wavelengths in the waveguide channels of the combined directional coupler and the associated difference in phase shifts of the waves at equal distances in the channels were taken into account in the synthesis and analysis of the CDC [5].

One of the main parameters of the CDC (Figure 2) is its directionality. To measure the directionality, we use the structural diagram shown in Fig. 3.

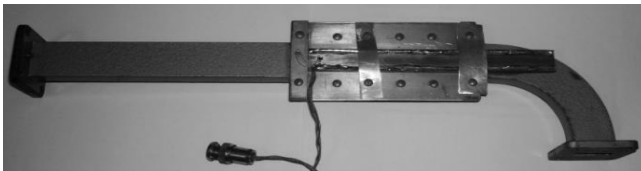


Figure 2 - Appearance of the combined directional coupler

We make voltage measurements in the frequency range - (8.2 ... 12.2) GHz. After that, we switch the detector head to the fourth arm of the directional coupler and perform voltage measurements at the same frequencies. Based on the results, measurements, we will construct a graph of the dependence of the orientation of the CDC on the frequency (experimental and theoretical data) in Fig. 4.

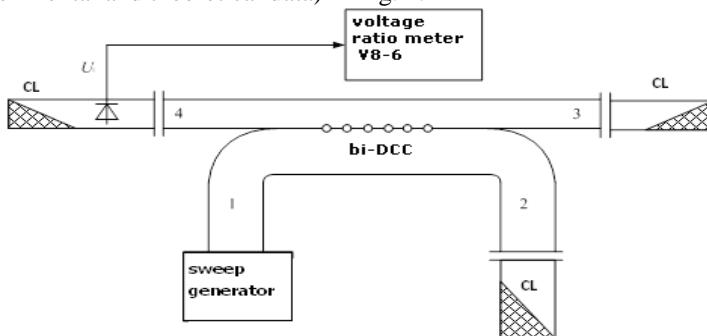


Figure 3 - Structural diagram for measuring the directionality combined directional couple

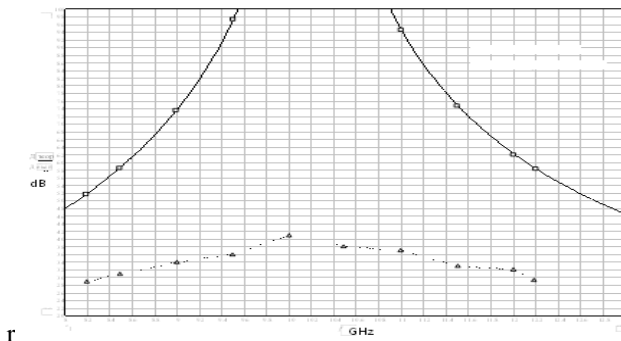


Figure 4 - Dependence of the orientation of the combined directional coupler from the frequency for the range (8.2 ... 12.4) GHz

**Conclusion.** Thus, the minimum practical orientation at the edges of the operating range is 29 dB, and the maximum directionality at the average frequency of the operating range was 41 dB. Obtained, the directivity results are sufficient to use a combined directional coupler in the measuring instruments.

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**Аннотация.** Представлены результаты экспериментальных исследований комбинированного направленного ответвителя, каналы которого выполнены на гетерогенных волноводах: металлическом и плоском металл-диэлектрике.

**Ключевые слова:** гетерогенный, полосовой металлodieлектрический волновод, полый металлический волновод, волноводные узлы, направленное соединительное устройство, детектор.

**Summary.** The results of experimental studies of a combined directional coupler are presented, the channels of which are made on heterogeneous waveguides: metal and flat metal-dielectric.

**Keywords:** heterogeneous, a strip metal-dielectric waveguide, hollow metal waveguide, waveguide nodes, directional coupler, detector.

UDC 612.396

## THE ANTENNA FOR TELECOMMUNICATION SYSTEMS

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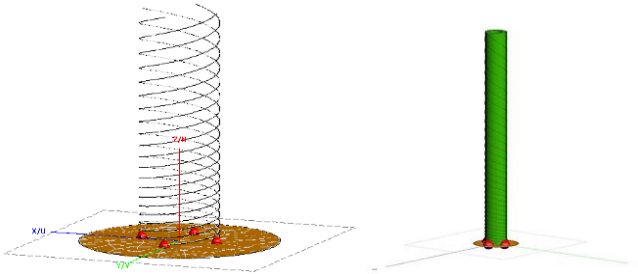
## INTRODUCTION

Today, in mobile and land-based telecommunication systems, mobile systems are widely used, operating in the microwave frequency range within the line of sight in a certain coverage area of the network of repeaters and base stations. When organizing such a network, much attention is paid to the choice of antenna equipment in terms of ensuring an optimal price-quality balance.

Therefore, the development of a reliable in use, structurally simple, small-size antenna with the directional pattern that is not directional in the azimuth plane and with circular polarization of the radiation field is an actual problem of great practical importance.

## MAIN PART

The four-way irregular helical antenna (IHA) shown in picture 1 is considered [1].



Picture 1 – Simplified three-dimensional model of four-way IHA in CAD (a) and refined model, performed taking into account the dielectric supporting cylindrical frame (b)

The geometry of each of wire of the spiral antenna for right-hand or left-hand winding is described in a parametrical form by the corresponding expressions given in table 1. Currents that feed the inputs of four-way IHA are equal  $i_1, i_2, i_3, i_4$ :

$$i_1 = I_{01} e^{j\varphi_1} ; i_2 = I_{02} e^{j\varphi_2} ; i_3 = I_{03} e^{j\varphi_3} ; i_4 = I_{04} e^{j\varphi_4} ,$$

where  $I_{01}, I_{02}, I_{03}, I_{04}$  – the currents amplitudes;  $\varphi_1, \varphi_2, \varphi_3, \varphi_4$  — the currents initial phases.

To feed the helical wires, the amplitudes of the currents applied to the inputs of the corresponding spiral paths are chosen from the relation

$$I_{01} = I_{02} = I_{03} = I_{04}$$

The polarizing structure of the four-way IHA radiation field defined by initial phases of the feed currents. For feeding of helical radiators the initial currents phases chosen relatively each other in a quadrature and in the certain sequence specified in table 2.

Table 1 — Geometrical parameters of helical wire

	Right-hand winding of helical wire	Left-hand winding of helical wire
First helical wire	$x(\alpha) = a \cos \alpha;$ $y(\alpha) = a \sin \alpha;$ $z(\alpha) = a \alpha \operatorname{tg} \beta(\alpha).$	$x(\alpha) = a \cos \alpha;$ $y(\alpha) = -a \sin \alpha;$ $z(\alpha) = a \alpha \operatorname{tg} \beta(\alpha).$
Second helical wire	$x(\alpha) = -a \sin \alpha;$ $y(\alpha) = a \cos \alpha;$ $z(\alpha) = a \alpha \operatorname{tg} \beta(\alpha).$	$x(\alpha) = a \sin \alpha;$ $y(\alpha) = a \cos \alpha;$ $z(\alpha) = a \alpha \operatorname{tg} \beta(\alpha).$
Third helical wire	$x(\alpha) = -a \cos \alpha;$ $y(\alpha) = -a \sin \alpha;$ $z(\alpha) = a \alpha \operatorname{tg} \beta(\alpha).$	$x(\alpha) = -a \cos \alpha;$ $y(\alpha) = a \sin \alpha;$ $z(\alpha) = a \alpha \operatorname{tg} \beta(\alpha).$
Fourth helical wire	$x(\alpha) = a \sin \alpha;$ $y(\alpha) = -a \cos \alpha;$ $z(\alpha) = a \alpha \operatorname{tg} \beta(\alpha).$	$x(\alpha) = -a \sin \alpha;$ $y(\alpha) = -a \cos \alpha;$ $z(\alpha) = a \alpha \operatorname{tg} \beta(\alpha).$

Note. In table 1 the signs are used

$\alpha$  – the central angle changing from 0 to  $2\pi n$ ;  $n$  — quantity of spiral turns;

$\beta(\alpha)$  – the angle of winding of spiral turns which changes under some law depending on  $\alpha$ ;  $a = d/2$ ;  $d$  – diameter of the forming cylinder.

Table 2 – The initial phases of feed currents

Initial phases of currents	Right-hand winding		Left-hand winding	
	$E_r$	$E_l$	$E_r$	$E_l$
$\varphi_1$ , degree	0	0	0	0
$\varphi_2$ , degree	270	90	90	270
$\varphi_3$ , degree	180	180	180	180
$\varphi_4$ , degree	90	270	270	90



In the developed antenna, initial phases of currents are chosen so that at right-hand winding of helical radiators the left-hand circular polarization is formed.

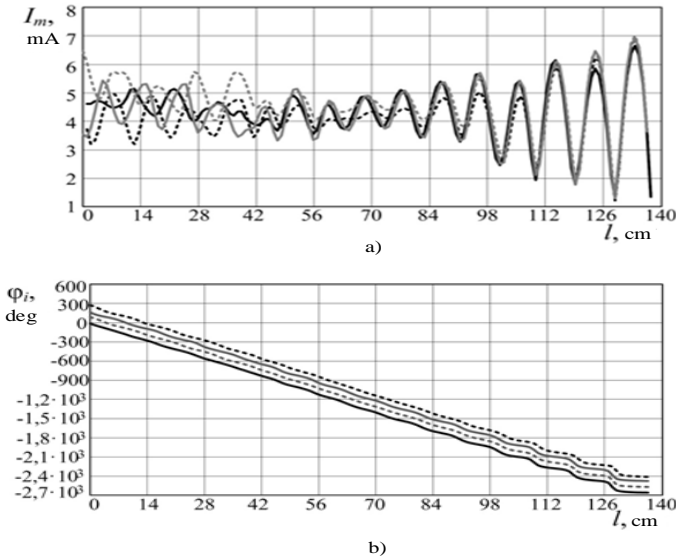
Calculations of radiation patterns (RP) of the irregular four-way IHA (4IHA) are carried out in the range of frequencies 2,1-2,6 GHz.

Based on the studies, the following groups of 4IHA geometric parameters are obtained and shown in table 3.

Table 3 — The 4IHA geometrical parameters

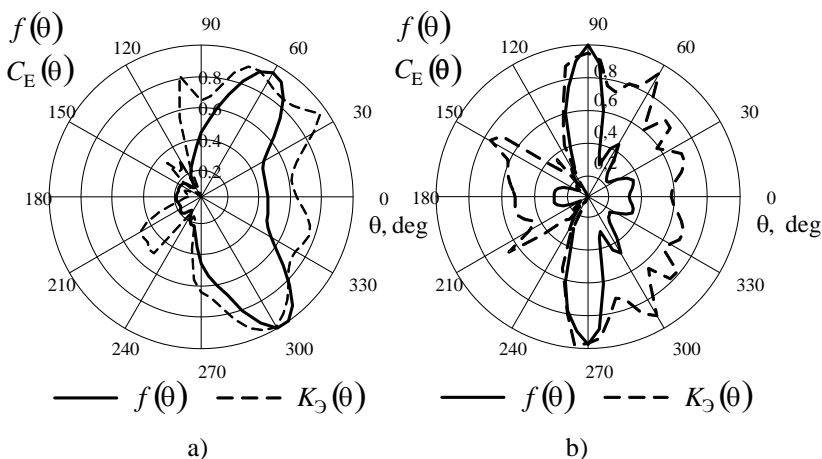
Antenna model	Radius of the forming cylinder, cm	Initial angle of winding of conductors, degree	Maximum angle of winding of conductors, degree	Quantity of turns
4IHA-1	1,3	13	29	6
4IHA-2	1,4	13	34	7
4IHA-3	1,4	13	36	8

At the specified geometrical parameters the 4IHA works in the non-standard for the helical antennas mode, which is characterized by distributions along the conductors of the amplitudes and phases of the currents shown in picture 2.



Picture 2 – Distribution of amplitudes (a) and phases (b) of currents along four irregular helical conductors

The picture 3 shows the amplitude radiation patterns ( $f(\theta)$ ) and ellipticity angular dependences ( $C_E(\theta)$ ) for 4IHA-1, 4IHA-2, 4IHA-3 at the frequency 2.4 GHz for the elevation plane.



Picture 3 – The radiation pattern and ellipticity angular dependence for 4IHA-1 (a),

4IHA-2 (b) in the elevation plane at the frequency 2.4 GHz

### CONCLUSION

4IHA forming non-directed radiation pattern in the azimuthal plane are developed. Antennas differs by the inclination of the main lobe concerning the line of the horizon from  $0^\circ$  to  $30^\circ$ . Also perhaps frequency scanning by the main lobe of the radiation pattern in any of the developed antennas in limits  $\pm 10^\circ$  from the central provision of RP. The antennas is characterized by circular polarization with  $K_e = 0,9\text{—}0,98$ .

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**Аннотация.** Представлены результаты разработки антенн с круговой поляризацией. Отличительными особенностями антенн являются: ненаправленная диаграмма направленности в азимутальной плоскости и узкая диаграмма направленности в угломестной

плоскости при смещении максимума излучения от линии горизонта на угол от 0 до 30°.

**Ключевые слова:** нерегулярная спиральная антенна, всенаправленная диаграмма направленности, круговая поляризация, телекоммуникационная система.

**Summary.** The results of the development of antennas with circular polarization are presented. The distinctive features of antennas are follows: the non-directional radiation pattern in the azimuthal plane and a narrow radiation pattern in the elevation plane while shifting the emission maximum from the horizon line at the angle from 0° to 30°.

**Keywords:** irregular helix antenna, omni-directional radiation pattern, circular polarization, telecommunications system.

UDC 62-52

## VESSEL AUTOMATIC MOORING SOFTWARE DEVELOPMENT

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The system consists of transponders and readers. It solves a system positioning tasks [1]. The hardware complex structure includes two readers located on the ship and two transponders installed on berth. Schematic of positioning system are shown in Fig.1. Each reader measure the distance to each transponder. As a result, four distances are obtained.

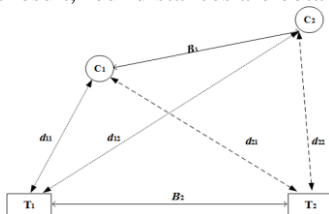


Figure1 — Location of systems readers and transponders

A vessel determination position is possible if distances between readers B1 and transponders B2, are known and also using elementary geometric expressions for the distances dij.

The software creation was the first system development step for the vessel's automatic mooring, using programming language C# in the Microsoft.Net environment. The vessel's automatic mooring mode initiates with the developed software launching that is especially designed for this system. The distance to the berth is determined by the GPS. Signal generated by the control device, based on GPS data. It sends data about the initial distance to the berth. The program selects the nearest value from the nonlinear distance scale based on GPS data.

Data exchange between the computer and the control device is carried out via Ethernet by the network adapter. The software calculates the distance on non-linear distance scale [2] with using the two-frequency method. The distance data is stored in memory and may be used by the vessel system.

The program interface in the SharpDevelop environment visual design mode, are shown in the figure. Ship Settings – allow to set the distance between the vessel sensors. To test the animation in the manual mode SD1 and SD2 groups, it is necessary to set the values of data received from the sensors. Pier Settings – allow to set the distance between the berth sensors. Metric Settings – establishes the correspondence between the image and the actual distance. IP address – allow the registration and data transfer network module address to specify. Data – is used for intermediate data to display, and also for system to debug. TextBox field used for display the response to the request via the Ethernet network registration and data transfer module.

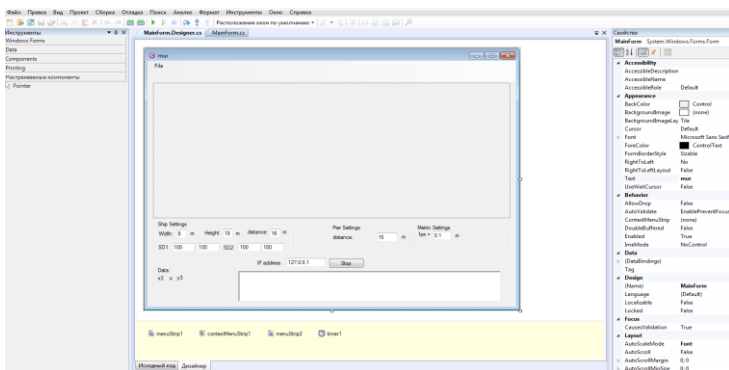


Figure 2 - The program interface in the visual design mode

The program interface are shown in figure 3. It provides vessel's mooring process visualization, using 2-D animation and the Windows Forms API [3].

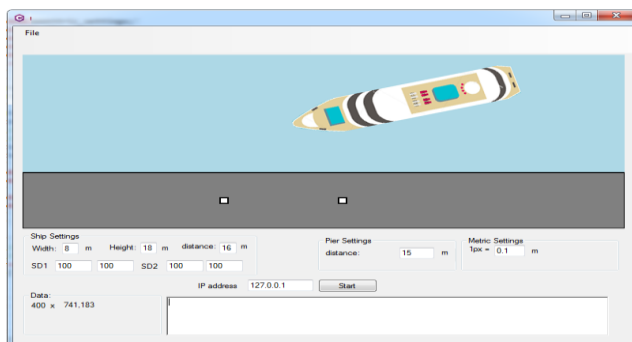


Figure 3 — Vessel mooring process program visualization interface.

After the Start, timer is requested the sensors data to receive via Ethernet connection. The received data are transmitted to subprogram for the ship (the Ship object) and berth (Pier object) graphic image formation.

In accordance with Metric Settings, the vessel location coordinates, the berth and the ship's rotation angle to the berth relation are calculated. Generated 2-D model displays the mooring process in real time mode. Data is transmitted to the Bitmap graphic object, for the next animation frame forming.

Vessel mooring algorithm for the visualization process in real time mode is shown in Fig. 4. More details about algorithm shown in [4].

The described software will be used in the process robotic vessel automatic mooring system practical implementation.

Proposed software system determining vessel position relative of the berth, has high accuracy.

Received coordinate data can be used by the ship control system and its positioning system. They have sufficient precision in the required range determining distance. The data is generated on vessel's board and can easily be integrated into control system.

This work was performed as a part of research №5.6208.2017 / 8.9 «The researching of vessel's automatic mooring principles» which performed at Sevastopol State University as a state task base part.

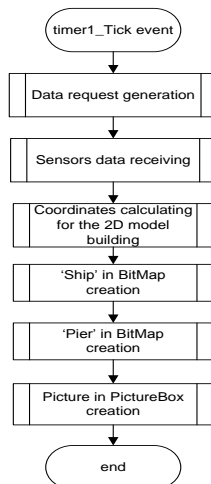


Figure 4 - Timer event processing block diagram

#### References:

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**Аннотация.** В статье описано решение локальной проблемы – разработка программного обеспечения, для автоматизированного причаливания судна, как часть глобального проекта, разрабатываемого на кафедре электроники и наноэлектроники, Севастопольского Государственного Университета.

**Ключевые слова:** судно, автоматическое причаливание, программное обеспечение, считыватель, транспондер, система позиционирования.

**Summary.** The article describes the solution of the local problem – software debugging and testing development for the vessel automatic mooring as a part of global project which are developed in Electronic and Nanoelectronics department Sevastopol State University.

**Key words:** vessel, automatic mooring, software, readers, transponders, positioning system.

UDC 62-97/-98

## ACTIVE ELECTRONICALLY SCANNED ARRAY

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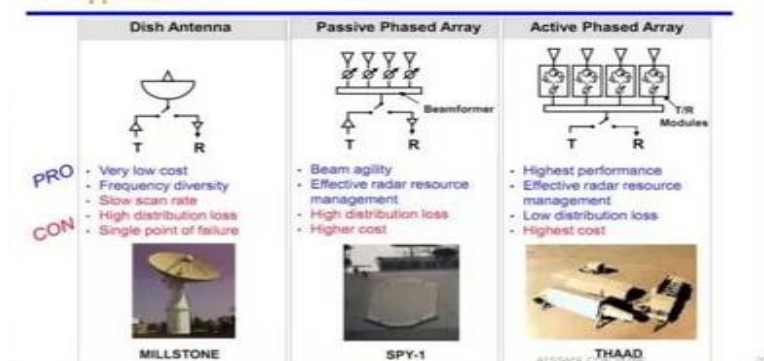
The emerging active array antenna technology was considered by Ashok K. Agrawal, Bruce A. Kopp, Mark H. Luesse, and Kenneth W. O'Haver. The following key parameters were stated by these scientists to be typically specified for an active array: operating frequency and bandwidth, effective isotropic radiated power, scan coverage, beamwidths, sidelobe levels (all monopulse receive channels), tracking accuracy, waveform parameters (duty, pulse width), system noise figure, third-order intercept, stability and phase noise, harmonic and spurious output, reliability, maintainability, and availability, manufacturing and life-cycle costs, prime power requirements and cooling, shipboard environmental requirements. They noted that key radar system-level advantages of active phased arrays over passive phased arrays are summarized as follows:

- increased sensitivity;
- improved target detection in clutter;
- improved waveform and pattern flexibility;
- improved wideband operation;
- reliable operation.

This invention relates to radar systems, in particular to techniques for microwave antennas, and can be used as both active and passive phased antenna array. Active electronically scanned array (AESA) is a phased antenna array in which the radiation direction and (or) the shape of the directivity diagram are regulated by changing the amplitude-phase distribution of currents or excitation fields on individual active emitting elements, each of which consists of an emitting element and an active device (receiving module). Due to the use of AESA in multi-functional radio locational stations almost inertialess scanning under any law, a control by the shape of the directional diagram and the type of signals, the level of emitting power can be carried out, which allows to adapt its characteristics (in transmission mode) to specific changing operating conditions and in reception mode – to implement the required signal-to-noise ratio in a given (required) frequency band

(see video [https://www.youtube.com/watch?v=e6mrW\\_hEgrE](https://www.youtube.com/watch?v=e6mrW_hEgrE)) (picture 1).

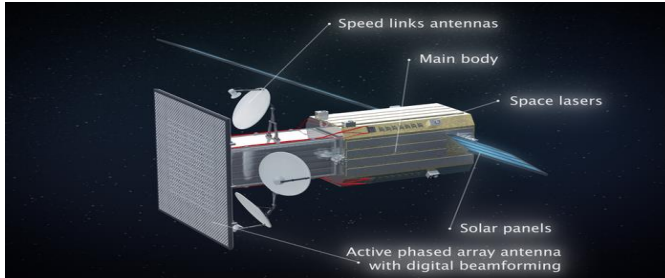
### ➤ Application



Picture 1 – Application of Arrays

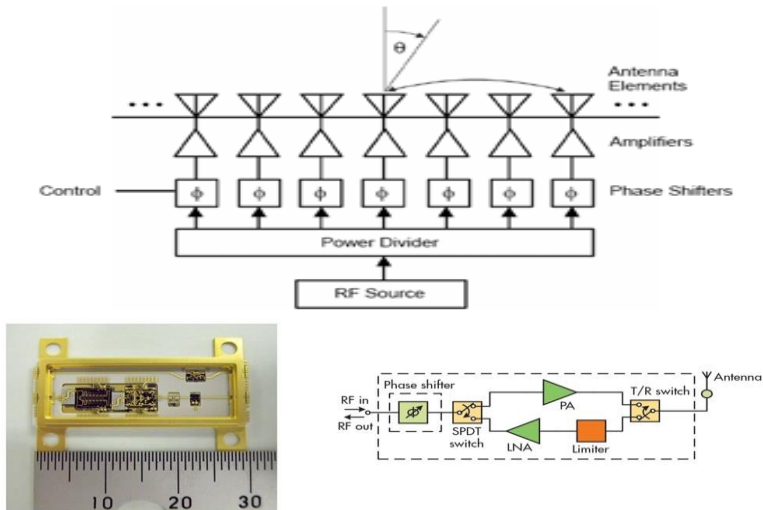
The transceiver module is the basis of space processing channel of a signal in AESA. It consists of an active element-amplifier, which makes this device electrodynamically non-changeable. Therefore, to ensure the ability of the device operation both on reception and on transmission in it, the transmitting and receiving channels are separated. Separation is carried out either by the switch or by the circulator. The receiving module regulates the initial phase of the carrier of the radio signal passing through the active emitting element, and also strengthens the radio signal transmitted or received by this element. More complex PPM can regulate the amplitude of the radio signal, convert radio frequency, as well as generate (generate) radio signal, convert it from analog form to digital one and (or) from digital to analog one (picture 2).





Picture 2 – Application of Active Phased Arrays

Active electronically scanned array (AESA) contains radiators which are connected to transmitting-receiving modules (TRM), device of distribution and phasing (DDP) and divider. Additionally the following components are introduced: shaper of radiation pattern, which has two inlets and four outlets, dividers (D), 2K-1 DDP, 2K peripheral control devices (PCD), for setting of required values of phase ratios, in accordance with control signals from beam control unit (BCU). At that every of four high-frequency (HF) outlets of FDN are connected to HF inlet of corresponding D (picture 3).

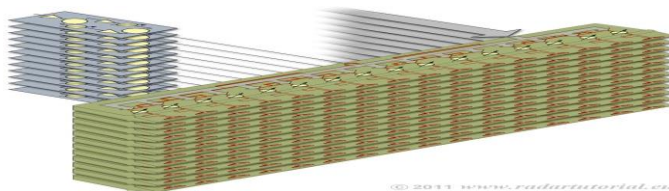


Picture 3 – Main features of AESA

AESA is a phased array antenna in which the radiation direction and (or) the shape of the directivity diagram are regulated by changing the amplitude-phase distribution of currents or excitation fields on individual

active emitting elements, each of which consists of an emitting element and an active device (receiving module). Due to the use of AESA in multifunctional radio locational stations almost inertialess scanning under any law, a control by the shape of the directional diagram and the type of signals, the level of emitting power can be carried out, which allows to adapt its characteristics (in transmission mode) to specific changing operating conditions and in reception mode – to implement the required signal-to-noise ratio in a given (required) frequency band (see video [https://www.youtube.com/watch?v=e6mrW\\_hEgrE](https://www.youtube.com/watch?v=e6mrW_hEgrE)).

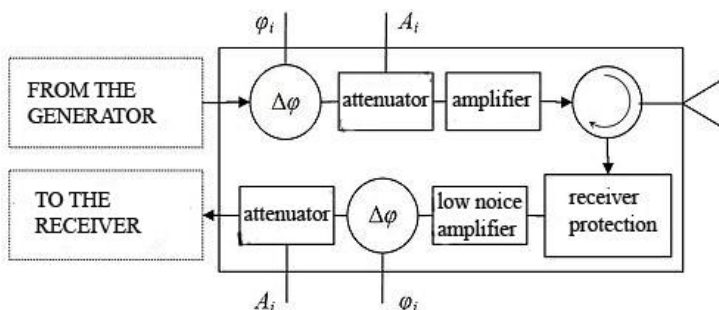
The transceiver module is the basis of space processing channel of a signal in AESA (picture 4). It consists of an active element-amplifier, which makes this device electro-dynamically non-changeable. Therefore, to ensure the ability of the device operation both on reception and on transmission in it, the transmitting and receiving channels are separated. Separation is carried out either by the switch or by the circulator. The receiving module regulates the initial phase of the carrier of the radio signal passing through the active emitting element, and also strengthens the radio signal transmitted or received by this element. More complex PPM can regulate the amplitude of the radio signal, convert radio frequency, as well as generate (generate) radio signal, convert it from analog form to digital one and (or) from digital to analog one.



Picture. 4 – Active phased antenna array

The structure of the receiving channel includes the following devices: device of the receiver protection – usually either the discharger or the other threshold device preventing overload of the receiving channel; low noise amplifier – two or more active signal amplification cascades; phase shifter – the device of phase signal delay in the channel to set the phase distribution throughout the lattice opening.

The structure of the transmitting channel is similar to that of the receiving one. The difference is in the absence of a protection device and lower requirements to the noise amplifier. However, the transmitting amplifier must have a greater output power than the receiving one (picture 5).



Picture 5 – Transceiver module AESA

Features of AESA.

In a conventional passive grid a single transmitter with a power of several kilowatts feeds several hundred elements, each of which emits only part of this power (tens of watts). However, the power of a modern microwave transistor emitter can also be tens of watts, and several hundred of such modules in the radar with AESA, each with a capacity of tens of watts, in general they create powerful main beam of several kilowatts (see video <https://www.youtube.com/watch?v=uc4Pyd3IH6g>).

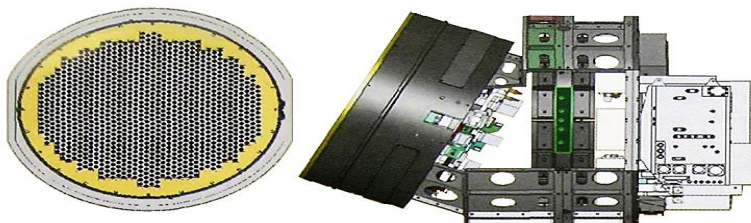
“The advantages of such systems are the ability to form and control the antenna diagram electronically, high energy efficiency, higher data transferring rates, longer range of system operation and a larger number of subscribers, which can be served by the base station simultaneously” (table 1).

Table 1. – Transceiver module characteristics

Frequency range	1,5 – 3,0	X
Input pulse power	1,5 – 10,0	mV
Ratio of the receiving channel noise	2,5 – 5,0	dB
Receiving channel reinforcement ratio	12 – 30	dB
Number of phase shifters discharges	6	unit
Number of attenuator discharges	5	unit
Performance	22 - 25	%
Mass	16 - 36	g

Active grids are much more reliable: failure of one receiving and transmitting element of the grid only distorts the antenna direction diagram,

reducing the characteristics of the locator, but in general it remains operational (picture 6).



Picture 6 – Features of APAA.

Another feature of active arrays is the ability to control the individual transmitting and receiving modules increasing. In this case, the range of deflection angles of the beam increases significantly; as a result, many of the limitations of the passive grids geometry can be bypassed.

An additional benefit is the weight savings: there isn't a large lamp with high power, cooling system and a massive power supply of high voltage connected with it.

Disadvantages of AESA.

Due to the disadvantages of microwave transistor amplifiers and monolithic integrated circuits, the transmitter module efficiency is usually less than 45%. As a result, AESA emits a large amount of heat that needs to be dissipated to protect the transmitter chips from melting.

Early modules cost about two thousand dollars, which did not allow the mass use of AESA. However, the cost of such modules with the development of technologies is constantly decreasing, since the cost of the development and production of microwave monolithic integrated circuits is constantly decreasing.

In conclusion it should be noted that AESA has found its application in airborne radar fighter jets, air defense systems and also for other ground vehicles, ships and even in such exotic devices as over-the-horizon radars. AESA installed in the satellites are very effective and useful. Despite the shortcomings, active phased arrays exceed the usual radar antenna, providing greater tracking ability and reliability despite complexity and cost.

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**Аннотация.** В статье представлены общие сведения об активной антенной решётке: принцип работы, сфера применения, достоинства и недостатки, а также характерные особенности по сравнению с другими антеннами.

**Ключевые слова:** активная фазированная антенная решётка, приёмопередающий модуль.

**Summary.** The article presents general information about the active antenna array: the principle of operation, field of application, advantages and disadvantages, as well as characteristics in comparison with other antennas.

**Keywords:** active phased array antenna, transceiving module.

UDC 622.248

## THE SYSTEM OF SEARCHING PEOPLE UNDER THE SHELLS IN THE MINES

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It is not always possible to find the victims in time because of the imperfection of search devices, as well as a number of other factors. To carry out the search and rescue of people caught in the rubble effectively, it is necessary to be able to work as long as possible on the source of autonomous power. It will provide the necessary amount of time for rescue work, as well as to increase the chances of saving people. The relevance of this article is to present a device capable of conducting searches for a long time. The device is effective and easy to use.

The search device consists of two parts: the radio beacon and the on-demand system. Working mines are equipped with a radio beacon, and the rescue team is equipped with a search system that consists of activation device and search equipment. Consider the principle of working with this device.

The activation device is located directly near the place of rescue work. It is necessary for the emission of an alternating magnetic field with a frequency  $f_1$ . The device consists of a timer, a generator of continuous frequency oscillations, a stationary coil with a ferromagnetic core. The power of the magnetic field radiation should be sufficient to enable the beacon to receive the signal. The generator of continuous oscillations includes  $\Delta t_1$  for a short time.

In each radio beacon, the signal is received by means of a coil with a ferromagnetic core. When the signal is received, a continuous oscillator with a frequency  $f_2$  is switched on for a short time  $\Delta t_2$ , thereby activating the beacon. In the radio beacon, the path of receiving and processing the signal at frequency  $f_1$  for a time interval  $\Delta t_2$  will be disabled. During the time  $\Delta t_2$ , the generated signal with frequency  $f_2$  is picked up by search coils and search is performed. If  $\Delta t_2$  fails to search for a time interval, then the activation device is switched on again for a short time  $\Delta t_1$ . Figure 1 shows the functional diagram of the device.

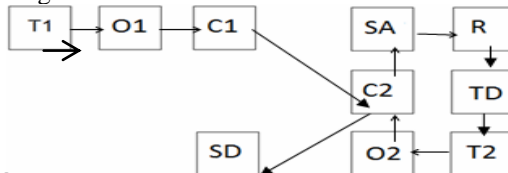


Figure 1 – Functional diagram of the device.

The device contains low-frequency oscillators (O1 and O2), coils with ferromagnetic cores (C1 and C2), a narrowband low-frequency signal amplifier (SA), a rectifier (R), a threshold device (TD), timers (T1 and T2), search devices (SD). O1, T8 and C1 form the activation device. C2, SA, R, TD, T9 and O2 form a radio beacon.

The device operates as follows: starts T1, which turns on O1 for a period of time  $\Delta t_1$ . It generates oscillations of a magnetic field of sufficient power with frequency  $f_1$  with the help of C1. The signal catches C2, which is part of the radio beacon. The signal from the receiving terminals C2 is fed to the signal input SA, which is also part of the beacon, where the received signal is amplified in a narrow frequency band, separating it from the industrial disturbances, and fed to the R, which is part of the beacon. The rectified signal is fed to the input of TD, which is part of the radio beacon. If the received signal of a certain threshold level is exceeded, T2 starts which for a time  $\Delta t_2$  includes O2, and also turns off the SA, which is part of the beacon. T2, with the help of C2, excites an alternating magnetic field with frequency  $f_2$ . This field is captured by SD. If the search failed during the time  $\Delta t_2$ , the procedure is repeated again.

The presented device allows increasing the duration of search for victims, which significantly increases the chance of their rescue. This is ensured by the fact that after receiving the signal, the continuous oscillator is turned on, and the signal reception handler is turned off and vice versa. It allows to keep the charge of the power source for a long time.

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**Аннотация.** Данная статья посвящена проблеме спасения людей при авариях на шахтах. Актуальность проблемы заключается в сложности нахождения людей под завалами из-за несовершенства поискового оборудования. Предлагаемое устройство состоит из маяка и поисковой системы. Радиомаяк имеет рабочих, а спасательная команда использует поисковую систему. Прибор возбуждения

посылает сигнал с некоторой частотой, и если он получен радиомаяком, то сигнал возвращается назад к поисковой системе. Это позволяет определить расстояние до радиомаяка под обломками. Сделан вывод об эффективности данного устройства.

**Ключевые слова:** горная промышленность, радиомаяк, устройство активации, мощность магнитного поля, ферромагнитный.

**Summary.** This article is devoted to the problem of saving people in accidents at mines. The urgency of the problem lies in the difficulty of finding people under the rubble due to imperfections in search equipment. The proposed device consists of a beacon and a search system. The radio beacon is equipped with workers, and the rescue team uses the search system. The excitation device sends the signal with some frequency, and if it is received by a radio beacon, the signal is sent back to the search system. This allows you to determine the distance to the radio beacon under the debris. The authors made a conclusion about the effectiveness of this device.

**Keywords:** mining industry, radio beacon, activation device, power of the magnetic field, ferromagnetic.

UDC 621.3.049.774

## **DIGITALLY CONTROLLED C-BAND ACTIVE ATTENUATOR**

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## **Introduction**

Active electronically scanned arrays (AESA) have been used for quite a number of years in the military domain and more recently for space applications. Nowadays AESA systems is promising for civil applications, especially for fifth generation (5G) telecommunication systems. The numerous advantages of this technique over mechanically directing antenna systems, including small sized and lightweight antennas, lack of mechanical parts, fast positioning, beam agility, has also lead to the adoption of the electronically steerable antennas to other applications. These include weather radars, light radars for security and control, radioastronomy, in-car entertainment via satellite links.



The technique is based on providing a correctly phased and attenuated signal at each of the elementary radiators forming the phased-array antenna. For this, digitally controlled phase shifters (PS) and attenuators (ATT) are required along with low noise amplifiers (LNA) and power amplifiers (PA), while commutation between transmit and receive modes is achieved by the use of microwave switches (SW). Previous generation systems have used individual monolithic microwave integrated circuits (MMIC) for each of the functional block. However, to reduce size, weight and production cost nowadays it is necessary to design fully integrated transceiver modules (Core Chips) that include most or all of the above functional blocks. Moreover, reduction in the cost of civil AESA systems can be achieved by designing Core Chips based on relatively cheap in mass production Si or SiGe technologies instead of expensive GaAs processes.

A typical block diagram of the Core Chip is shown in figure 1.

Passive circuits based on cascaded units are traditional choice to implement integrated attenuator. Relatively large dynamic range and low power consumption are main advantages of such solution. Main disadvantages are significant initial insertion loss, relatively high attenuation error and large required crystal area. These disadvantages are more significant in passive attenuators designed on the basis of Si and SiGe technologies due to relatively high open channel resistance of the MOS transistors used for switching sections. The variable gain amplifier (VGA) has no such shortcomings. It is used to control the output signal amplitude depending on the external digital control signal.

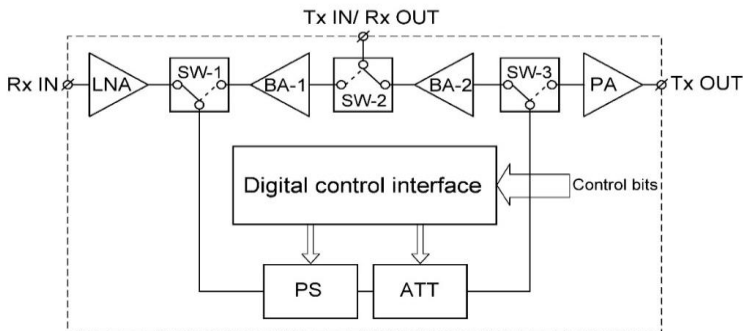


Figure 1 — Block diagram of the typical Core Chip

In figure 1 the following notations are accepted: LNA – low noise amplifier; SW – switch; BA – buffer amplifier; PA – power amplifier; PS – phase shifter; ATT – attenuator.

The actuality of the VGA design is associated with the possibility of calibrating the attenuation states after production. It makes possible to reduce the influence of temperature and technological parameters mismatch on the characteristics of Core Chip MMIC.

Design of C-band digitally controlled active attenuator is a part of research project «Design of microwave integrated circuit for AESA beam forming modules based on silicon technology», project code: 8.3962.2017/ПЧ which is held in Engineering center of micro- and nanoelectronics devices, Sevastopol State University.

## Overview

### A. Block diagram

Block diagram of the designed VGA consists of VGA core and gain control circuit. It is shown in figure 2.

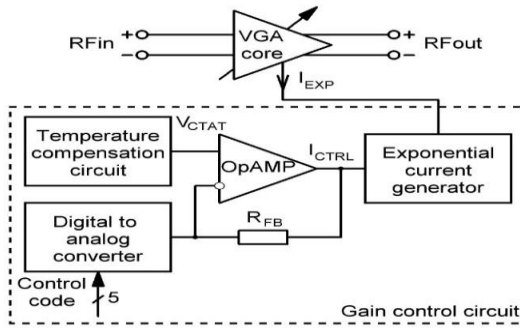


Figure 2 — Block-scheme of the active attenuator

VGA core main function is to change amplitude of radio frequency (RF) signal depending on control current  $I_{EXP}$ . Current  $I_{EXP}$  is formed by exponential current generator, which is a part of gain control circuit. Gain control circuit also contains operational amplifier (OpAmp), temperature compensation circuit and 5-bit digital-to-analog converter (DAC).

Exponential current generator provides the linear-in-dB control characteristic of VGA core. This kind of dependence makes it possible to form accurately the amplitude –phase field distribution in the antenna array.

Temperature compensation circuit generates the complementary-to-absolute-temperature direct voltage  $V_{CTAT}$ . This voltage uses for compensate temperature instability of the VGA core gain (gain rises with rise the temperature). Output signal from DAC is directly proportional to 5-bit external digital control signal.

Input signal for exponential current generator is  $I_{CTRL}$ , which is generated by OpAmp. This signal depends on  $V_{CTAT}$  and DAC output signal.

### B. Schematic Diagrams

Schematic diagram of VGA core is present in figure 3.

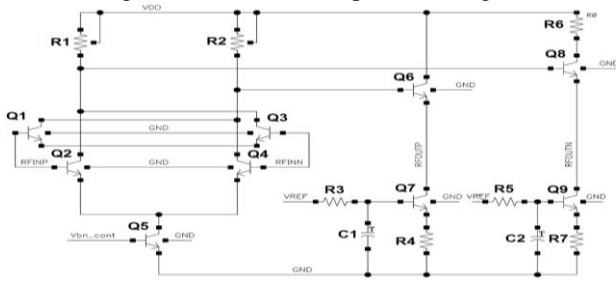


Figure 3 – Circuit diagram of VGA core

VGA core is based on classic differential stage (transistors Q2 and Q4) with resistive load R1 and R2. Bias current of differential stage is controlled by transistor Q5. Bias voltage for Q5 is generated by gain control circuit and depends from control code value and temperature of crystal. In order to increase VGA core dynamic range cross-coupled floating-emitter transistor dummy pair (Q1, Q3) is used. Using emitter followers at output of differential stage allows get good matching between attenuator and next stage in Core Chip.

In figure 4 gain control circuit schematic diagram is shown.

DAC scheme is based on cascades of the current mirrors. Transistors VT1 and VT3 sets the initial offset of the VGA core transfer ratio. Transistors VT24—VT26 produces reference current for cascaded current mirrors. Dimensions of transistors in current mirror differ by two times for provide linear dependence the DAC output current from external control signal. Temperature compensation circuit includes transistor Q1 and resistor R1.  $V_{CTAT}$  generates at the collector of Q1 due to temperature dependence of p-n junction potential.

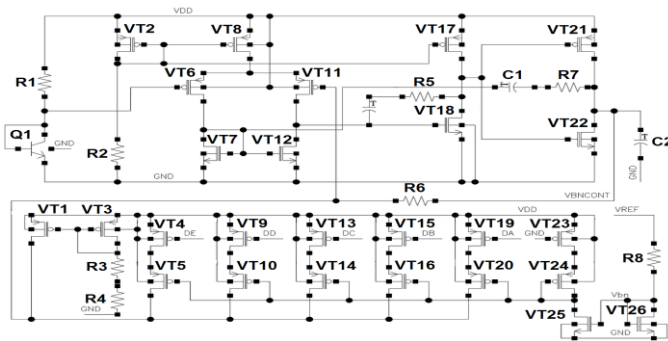
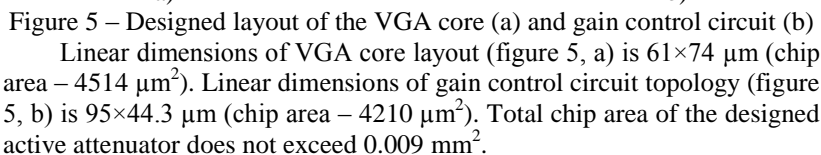


Figure 4 — Circuit diagram of the gain control circuit

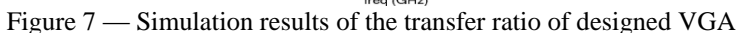
In figure 5 fragments of designed layout of the VGA are shown.



VGA core and gain control circuit layout are presented separately in view of the fact that microwave and digital functional blocks should be located in different regions of the Core Chip layout.

Integrated inductors could be used in order to achieve proper impedance matching of VGA core to 50 Ohm source impedance. However, it will lead to increasing of the designed layout area.

Simulation results of the transfer ratio and relative phase shifts within the changes of external control code, frequency changes from 4 to 6 GHz are shown in figures 7, 8.



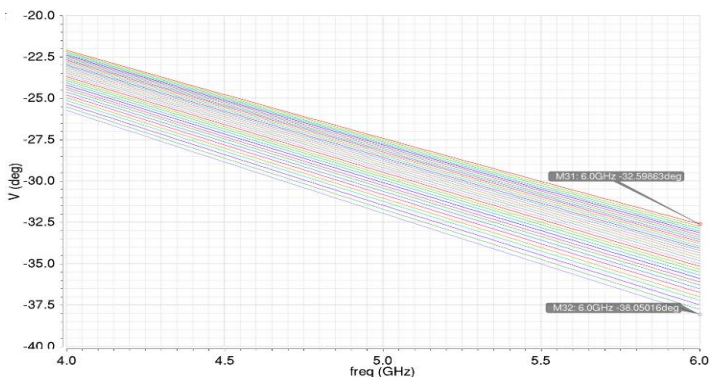


Figure 8 — Simulation results of the relative phase shifts of designed VGA

In table 1 the resulting post-layout simulation parameters of the digitally controlled VGA are shown.

Table 1 — Variable gain amplifiers characteristics comparison

	[1]	[2]	[3]	[4]	[5]	This work
Frequency range, GHz	0.003—1.7	0.003—3.55	0—5	0—29	0.1—0.9	4—6
Attenuation range, dB	-1.4—30.2	-22.4—42.3	-2—38	-23—14	-72—5	-31—0
Attenuation step, dB	0.5	—	—	—	—	1
Attenuation error, dB	0.1	—	—	—	1.5	0.6
Output P1dB, dBm	-10	-5.2	3	$\geq 7.5$	-6.8	—
Noise Figure, dB	—	26.1	$< 23$	—	—	$< 18$
Supply voltage, V	1.8	1.8	$\pm 2.5$	—	2.7—5	2.5, 5
Power consumption, mW	35	3.7	775	247	30	17.3
Chip area, mm <sup>2</sup>	0.25	—	0.57	0.23	1.11	0.009
Technology	0.18 $\mu\text{m}$ SiGe BiCMOS	0.18 $\mu\text{m}$ SiGe BiCMOS	0.35 $\mu\text{m}$ SiGe BiCMOS	0.13 $\mu\text{m}$ SiGe BiCMOS	0.8 $\mu\text{m}$ HSB3	0.18 $\mu\text{m}$ SiGe BiCMOS

## Conclusion

The paper presents C-band digitally controlled active attenuator with a maximum relative attenuation and phase errors of less than 0.6 dB and 5.4 degrees respectively. It provides possibility of a discrete gain control ranging from 0 dB to -31 dB in steps of 1 dB (5 bits) with a 30° signal phase shift. Noise figure is less than 18 dB. Power consumption is 17.25 mW. Chip area — 0.009 mm<sup>2</sup>.

This design is intended for use as a part of Core Chip MMIC. This class of integrated circuits in nearest future should become the basis of next-generation telecommunication equipment.

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**Аннотация.** В статье представлены результаты разработки и моделирования структурной схемы, принципиальной схемы и топологии активного интегрального аттенуатора С-диапазона. При разработке использовались правила проектирования и библиотеки *SiGe* БиКМОП технологического процесса с топологическими нормами 0,18 мкм. Приведены результаты пост-топологического моделирования разработанного аттенуатора. Моделирование

производилось в специализированном программном пакете *Cadence IC Design Environment*.

Согласно результатам моделирования, аттенуатор способен обеспечить изменение коэффициента передачи в диапазоне от 0 до – 31 дБ с шагом в 1 дБ. Коэффициент шума схемы не превышает 18 дБ. Потребляемая мощность составляет 17,25 мВт. Моделирование аттенуатора показывает, что в полосе частот 4-6 ГГц абсолютная ошибка установления коэффициента передачи не превышает 0,6 дБ при абсолютной фазовой ошибке менее 5,4°.

**Ключевые слова:** монолитная интегральная схема, микросхема, *SiGe*, БиКМОП, аттенуатор, усилитель с управляемым коэффициентом передачи, приемо-передающий модуль АФАР.

**Summary.** The paper presents a design and simulation results of the block and schematic diagrams, and layout of C-band active integrated attenuator. In a design process rules and libraries of a 0.18  $\mu\text{m}$  *SiGe* BiCMOS technology were used. Designed attenuator post-layout simulation result are shown. Cadence IC Design Environment software package were used in designing process.

According to the simulation results, attenuator provides transfer ratio change from 0 to –31 dB with linear 1 dB step. Noise is figure less than 18 dB. Power consumption is 17.25 mW. Attenuator simulation shows, that absolute attenuation error with a absolute phase error are less than 0.6 dB and 5.4° respectively in 4-6 GHz bandwidth.

**Keywords:** monolithic integrated circuit, microchip, *SiGe*, BiCMOS, attenuator, programmable gain amplifier, AESA transceiver module.

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## **AN 4-6 GHz *SiGe* BiCMOS LOW NOISE AMPLIFIER FOR THE TRANSMIT/RECEIVE MODULES OF AESA**

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### **Introduction**

Low noise amplifier (LNA) is the main element of any transmit/receive module (TRM). The function of the LNA is the pre-amplification of the signals induced in antenna without significant deterioration in the signal-to-noise ratio. In particular, the integrated LNA is

a necessary functional block of the TRM of active electronically scanned arrays (AESA), which are used in radar and radio navigation systems, electronic warfare, and also in telecommunication systems for various purposes.

### Main part

The block diagram of the developed LNA is shown in Figure 1. The first cascade with a common base (CB) was selected to achieve good matching of the input impedance of the LNA with 50 Ohm, as well as a low noise factor (NF). Common base amplifier has a low input impedance and a small parasitic negative feedback from the collector to base, which reduces the gain at high frequencies. Also, the advantages of the CB scheme include stable temperature and frequency properties.

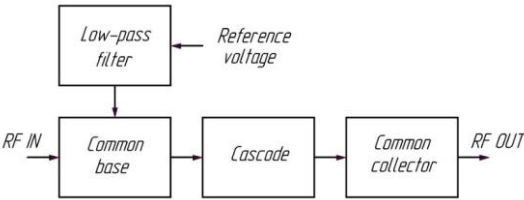


Figure 1 — The block diagram of the LNA

Using cascade amplifier as the second stage can reduce the influence of the Miller effect [1, p. 353] and obtain high gain. The cascode has increased stability of operation and a small input and throughput capacity. The emitter follower is used to obtain a low output impedance and reduce nonlinear distortion.

The low-pass filter (LPF) is necessary to stabilize the operating point of the first stage and to reduce the noise figure.

Cadence IC Design software package with 0.18  $\mu\text{m}$  SiGe BiCMOS libraries was used for the development of electrical scheme and simulation. The simplified electrical circuit of the developed LNA is shown in Figure 2.

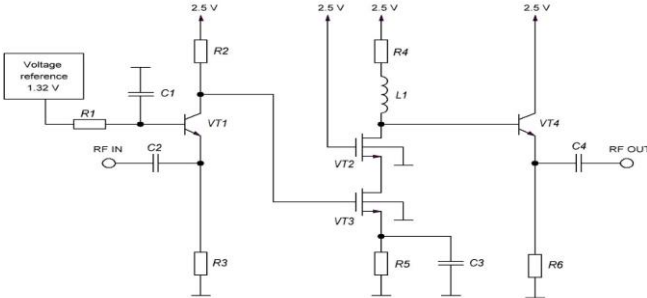


Figure 2 — The simplified electrical scheme of LNA



The bias voltage of the transistor VT1 is  $\sim 1.32$  V and is set using the reference voltage [2, p. 168]. To the bias voltage on the gate of the transistor VT3, no stringent requirements are imposed, since the operating point can be set in a relatively wide range of voltages, taking into account the amplitude of the signal at the output of the first stage. Therefore, the potential on the collector of the transistor VT1 is used for the bias. The bias voltage of the transistor VT4 is set similarly.

Figure 3 shows the frequency response of the electrical circuit at three different temperatures:  $-60$  °C,  $27$  °C and  $85$  °C. It can be seen from the graphs that the spread of the gain in the operating frequency band doesn't exceed 2.7 dB.

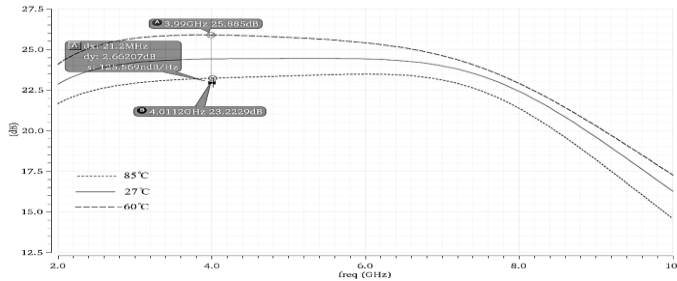


Figure 3 — Voltage gain at various temperatures

One of the important distinctive features is the temperature at which the noise figure is measured. A meaningful comparison of the noise figure values requires that measurements be taken at standard temperature. As a standard temperature in the scientific community, a temperature of 290 K ( $17$  °C) was chosen. Dependence of the noise figure on the frequency of the input signal at a temperature of  $17$  °C is shown in Figure 4.

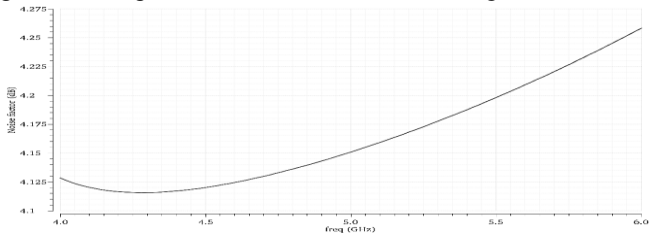


Figure 4 — Dependence of noise factor on frequency

It can be seen from the graph that the noise factor of the developed circuit in the frequency range 4-6 GHz does not exceed 4.3 dB, which is a good value for a LNA based on SiGe technology.

The input impedance of the developed amplifier is matched with 50 ohms. The quality of the matching can be estimated using parameter  $S_{11}$  (input return loss). The dependence of  $S_{11}$  on the frequency of the input signal of the LNA is shown in Figure 5. The simulation was carried out at a temperature of 27 °C.

The simulated output 1-dB compression point  $OP_{1dB}$  at 5 GHz equals – 12.3 dBm (Figure 6).

Table 1 summarizes the performance of the presented LNA, with comparison to previously published LNAs.

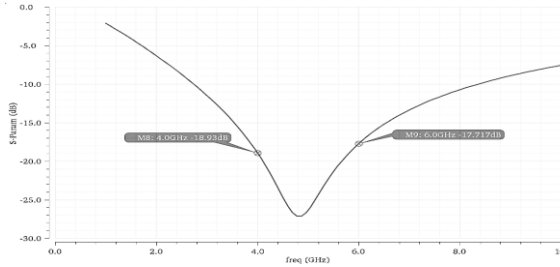


Figure 5 — Simulated input return loss

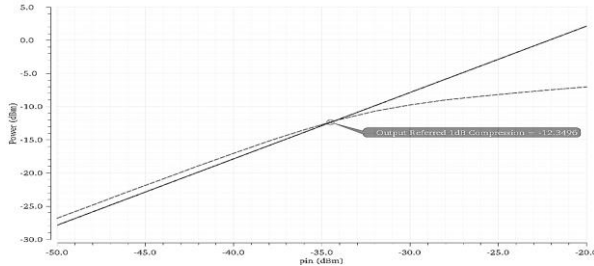


Figure 6 — Simulated output 1-dB compression point at 5 GHz

Table 1 – Comparison the presented LNA with previously proposed LNAs

Spec.	This work	[3]	[4]	[5]		[6]
Technology	SiGe 0.18 um	SiGe 0.18 um	CMOS 0.18 um	SiGe BiCMOS		CMOS 0.18 um
Band, GHz	4—6	3—10	3.1— 10.6	3.1—10.6		1—5
Gain, dB	24	21	9—10	16—17	23— 23.5	11—14
NF, dB	4.1—4.3	2.5—	4—7	2.4—3	3—4	5—6.5

		4.2				
Max. $ S_{11} $ , dB	-17.7	-10	-10	-4	-6	-12
OP <sub>1dB</sub> , dBm	-12	—	—	-13.5	-19.5	—
Power, mW	15	30	9	55	9	

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**Аннотация.** В статье представлены результаты разработки интегрального малошумящего усилителя С-диапазона для приёмо-передающих модулей АФАР гражданского назначения. Разработана электрическая схема интегрального МШУ и проведено моделирование в системе автоматизированного проектирования (САПР) *Cadence IC Design* в рамках 0,18 мкм *SiGe* БиКМОП технологического процесса.

Разработанная схема МШУ в диапазоне частот 4-6 ГГц обеспечивает усиление 24 дБ, коэффициент шума менее 4,3 дБ. Потребляемая мощность 15 мВт от источника питания 2,5 В. Точка децибельной компрессии по выходу не превышает –12 дБм.

**Ключевые слова:** малошумящий усилитель, МШУ, *SiGe*, БиКМОП, С-диапазон, АФАР.

**Summary.** The article presents the results of the development of an integrated low-noise C-band amplifier for the transmit/receive modules of AESA for civil purposes. Cadence IC Design software package with 0.18  $\mu\text{m}$  SiGe BiCMOS libraries was used for the development of electrical scheme and simulation.

The developed LNA scheme in the frequency range 4-6 GHz provides 24 dB gain, noise figure less than 4.3 dB. The power consumption is 15 mW from the 2.5 V power supply. The simulated output 1-dB compression point  $\text{OP}_{1\text{dB}}$  at 5 GHz equals  $-12.3$  dBm.

**Keywords:** low noise amplifier, LNA, SiGe, BiCMOS, C-band, AESA.

UDC 62-05

## **SEX AND GENDER INTEGRATING INTO ENGINEERING PROCESS**

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Integration of knowledge about sex and gender provides the basis for the inclusion in the innovation of engineering processes and technological productions. "Gendered Innovations harness the creative power of sex and gender analysis for innovation and discovery. Considering gender may add a valuable dimension to research. It may take research in new directions. The term "Gendered Innovations" was coined by Londa Schiebinger in 2005.

The peer-reviewed Gendered Innovations project:

1) develops practical methods of sex and gender analysis for scientists and engineers;

2) provides case studies as concrete illustrations of how sex and gender analysis leads to innovation" [6, www].

The method of gender integration is designed to explain the meanings of such concepts as Sex Analysis, Gender Factor, Gender Relations, and their fundamental importance in innovation.

Integrating sex and gender into engineering innovation may:

1. Lead to new products, processes, infrastructure, or services.
2. Lead to design that promotes human well-being, including gender equality.
3. Identify new markets and business opportunities.
4. Develop technologies that meet the needs of a complex and diverse user group.
5. Enhance global competitiveness and sustainability.

Many engineering organizations have their own means of managing innovation. This method can offer a list of elements that will help in the development of the innovation process. Such elements are described below.

One route to developing Gendered Innovations is to recognize how choices made in the development of past innovations and technologies may have served certain groups of women or men more than others.

Where have past innovation processes been unfair in relation to the two sexes?

Methodology—whereby designers create products for users whose interests, abilities, and needs resemble their own—may result in a “male default” because men tend to be the majority of engineers in many economic sectors, such as automotive design and IT.

One of the problems of gender disagreement is the unconscious process of engineering innovation, aimed at the needs of only one sex, forgetting about the needs of the other.

When differences between women and men were considered, are they based on stereotypes? Stereotyping fails to capture actual people’s attitudes and behaviors. Products or systems based on stereotypes may press people to conform to limiting or unequal roles. Potential customers and users may resent being constrained in this way and look elsewhere or modify products in an unauthorized manner. Products or systems based on stereotypes may reinforce or contribute to gender and other inequalities and not contribute to enhancing social justice or corporate social responsibility [3].

When products or systems are designed specifically for girls or women, are they built on stereotypes? Simply “pinkening” plays to stereotypes and may miss important aspects of diversity in women’s markets. For example, when Philips designers asked young girls what they thought about a toy called Kidcom that they were developing, the children rejected the round shapes and pink coloring that the designers had stereotypically chosen [5].

Perspectives can be broadened by means of including women – their experiences, knowledge, and networks – on the design team. It is an important reason of social justice, but does not ensure gendered innovation. One woman on a team, for example, does not represent all women [1].

Including gender expertise can maximize innovation. Eventually, everyone on the team – women and men – will want to learn methods of sex and gender analysis relevant to their area. This is the most efficient way to rethink research priorities and to formulate research questions that lead to innovation.

“Governments and universities have taken three strategic approaches to gender equality over the past several decades:

1. "Fix the Numbers of Women" focuses on increasing women's participation.

2. "Fix the Institutions" promotes gender equality in careers through structural change in research organizations (NSF; European Commission, 2011).

3. "Fix the Knowledge" or "gendered innovations" or the "gender dimension" stimulates excellence in science and technology by integrating sex and gender analysis into research” [6, www].

Relevant gender variables are cultural, and they are related to specific gender norms, gender relations, and gender identities. Gendered behaviors in potential applications may shape patterns of use or access, etc. When considering gender, engineers should ground gender analysis in empirical evidence about actual people and actual practices, wishes, needs, and so on. Basing design on gender stereotypes may lead to unsuccessful products or systems.

It is important to analyze differences between men and women, but one should also recognize and understand similarities (see figure 1).

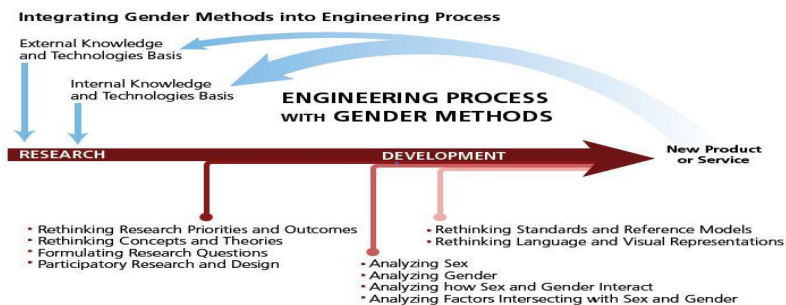


Figure 1 – Integrating Gender Methods into Engineering Process

It is important to analyze sex and gender, but it is also necessary to examine other factors intersecting with sex and gender [4]. These factors or variables can be biological, socio-cultural, or psychological. Factors include age, reproductive status, educational level, socioeconomic background, and sexual orientation.

Very important aspects are user observations of gender phenomena in everyday life. Rational practice requires an analysis of outcomes. “Organizations will want to:

- consider both benefits and problems of the current product, process, service, or infrastructure. What successes can be built upon and what difficulties overcome?

- consider how to develop gender expertise further. How can what was learned be further used across an organization and its innovation partners? What additional gender expertise is needed for future projects” [1, www].

It should be noted in the conclusion that gendered innovations:

1. Add value to research and engineering by ensuring excellence and quality in outcomes and enhancing sustainability.

2. Add value to society by making research more responsive to social needs.

3. Add value to business by developing new ideas, patents, and technology [6].

“Analyzing data related to elder care, using sex and gender analysis, reveal new opportunities for assistive technologies and robotics. Researchers have studied the different needs of women and men as they age. This research along with collaboration with the elderly, their caregivers, and further stakeholders, provide engineers key insights for designing and developing assistive products that are useful to a broad user base” [2, www].

The goal of the Gendered Innovations project is to provide scientists and engineers with practical methods for sex and gender analysis. To match the global reach of science and technology, methods of sex and gender analysis were developed through international collaborations

Despite the fact that the assessment may not be entirely correct, engineers should not dwell on the heavy task of innovation. They should take a more detailed approach to the ideas of developing their own products and direct them to the infrastructure. Soon the results of such progress will be known.

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**Аннотация.** Автор полагает, что в среде используемых человечеством технологий возникает “гендерное неравенство“, основание которого лежит в принципах “стереотипов“, то есть имеет место думать, что инженерный процесс-это часть мужской области деятельности. Разумеется, это не так. Данные этого доклада призваны установить, что и женщины отдают предпочтение разработке инженерного процесса и любимым технологиям, применяемых в повседневной жизни.

**Ключевые слова:** пол, гендер, инженерный процесс, технологии, машиностроение, инновация, ориентации.

**Summary.** The author believes that among the technologies used by mankind there is a "gender inequality", the basis of which lies in the principles of "stereotypes", that is, it is believed that the engineering process is part of the male field of activity. Of course, this is not so. The data of this report are intended to establish that women prefer engineering and the favorite technologies used in everyday life.

**Keywords:** sex, gender, engineering process, technologies, mechanical engineering, innovation, orientations.



UDC 656.052.5

**AN OVERVIEW OF THE MAIN DIRECTIONS OF ENSURING  
NOISE IMMUNITY OF SATELLITE NAVIGATION SYSTEMS IN  
TERMS OF PERTURBATIONS OF THE EARTH'S IONOSPHERE**

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Since the advent of satellite navigation, it is known that the signals received in the frequency range of 10-500 MHz are subject to fluctuations in phase and amplitude (i.e. fading). Later studies of the conditions of propagation of radio waves through the Equatorial and polar ionosphere showed the possibility of fading in the frequency range up to 6 GHz [1]. As a result of these observations, it was found that fluctuations in the parameters of the received signals are caused by small-scale inhomogeneities of the ionosphere (mainly F-layer), which have a turbulent character.

The known methods of statistical theory of communication show [2] that the presence of fading in the communication channels leads to a significant reduction in noise immunity of the optimal signal processing schemes against the background of fluctuating noise. However, the relationship between the probability of erroneous reception ( $P_{er}$ ) signals in satellite navigation systems (SNS), the frequency parameters of the transmitted signals (the carrier frequency  $f_0$  and a spectral width of  $\Delta f_0$ ) and the physical parameters of the ionospheric inhomogeneities to the present time is the subject of scientific research.

Recently, theoretical and experimental studies have been actively conducted to study the influence of the disturbed ionosphere (DI) on the

fluctuation of the received signal parameters and SNA noise immunity [3]. These disturbances can occur under the influence of both natural factors (e.g., solar and magnetic storms) and artificial ones. The latter include space explosions (conventional and nuclear charges), the release of light ionizing chemicals, radionavigation of the ionosphere by powerful terrestrial transmitters, the operation of rocket engines, special electronic accelerators, etc. The influence of these disturbing factors can be accompanied by an increase in the intensity of ionospheric inhomogeneities and, as a consequence, the occurrence of fading in the trans-ionospheric data transmission channels (TDC) at frequencies  $f_0 > 6$  GHz. Particular attention should be paid to the fact that DI can cause fading not only smooth (General) type, but also frequency-selective, if the ratio is

$$\Delta f_0 \geq \Delta f_{\text{coh}}, \quad (1)$$

where  $\Delta f_{\text{coh}}$  — the coherence band of trans-ionospheric communication channels.

When the condition (1) is met, not only the amplitudes and phases of the SNA signal, but also the shape of its envelope, will be subject to random fluctuations. The latter circumstance causes the appearance of energy losses in the processing of received signals (due to their misalignment in form with the receiver reference signal) and, as a consequence, an additional reduction in noise immunity of reception devices of SNS radio systems. Since DI causes narrowing  $\Delta f_{\text{coh}}$ , according to (1) the greatest risk of frequency-selective fading subject TDC using signals with spread spectrum. Given that the latter are widely used in modern radio navigation systems, the issues of the influence of inhomogeneities of the disturbed ionosphere on the noise immunity of the receiving devices of the SNS radio systems are currently very relevant.

This can be confirmed by the results of studies related to the creation of DI by the release of easily ionized substances (48 kg barium). Figure. 1 presents the prediction results of the noise immunity of noncoherent reception in the receptors obtained in the framework of these programs (i.e., according to the  $P_{\text{er}}$  from the ratio between the average signal energy at the receiver input to the spectral density of the fluctuation of interference  $\overline{h_0^2} = \overline{E_s} / N_O$  for different ratios between  $\Delta f_{\text{hoc}}$  and  $\Delta f_0$ ).

The analysis of the given graphs allows to draw the following conclusions:

— the energy potential of modern SNS radiolines (providing the value of  $h_0^2 \sim 13$  dB) may not be sufficient to obtain the required in modern systems  $P_{\text{er}} \sim 10^{-5}$  under the influence of the strongly perturbed Earth's ionosphere;

— an increase in the SRS band, providing an increase in noise immunity of the receiver of the SNS radio systems to the effects of active noise, can lead to a significant deterioration of their noise immunity in the event of exposure to VI;

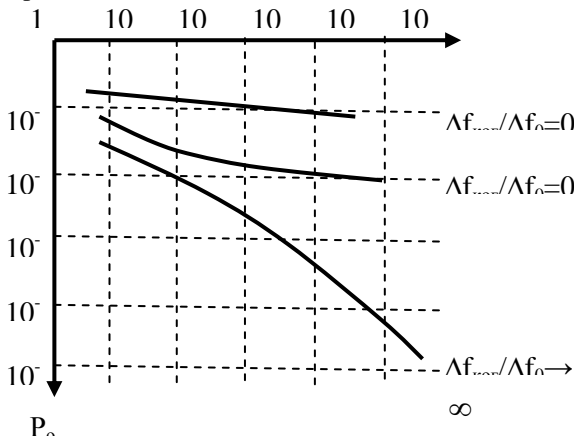


Figure 1 — Noise immunity of incoherent reception of signals with extended spectrum in space navigation systems

— to provide the required noise immunity of radio systems receivers of space radio navigation systems using SRS and optimal schemes of their processing against the background of fluctuating noise, by increasing the energy reserve of radiolines is fundamentally impossible in the case of exposure to strong DI.

These conclusions make it possible to draw an important conclusion about the existence of the problem of providing the required noise immunity of modern receivers of SNS radio systems in DI conditions, which can be solved only by improving the methods of signal generation and processing.

The key link for the solution of the above problem is to find new methods for predicting noise immunity of modern receivers of SNS radio systems under the influence of DI.

factor of RWP through the unperturbed ionosphere on the noise immunity of receiving devices of the SNS radio systems in order to obtain a functional dependence of the magnitude of Roche on a number of independent variables: frequency parameters of transmitted signals and physical parameters of the ionosphere.

According to the General scheme of analytical forecasting of quantitative characteristics of any object [4], this method should include the following main stages.

1. Establishment of General laws of influence of factors of the trans-ionospheric RWP on parameters of the signals accepted in SNS and noise immunity of schemes of their processing.

2. Development of a mathematical model of the influence of the most significant factor of RWP through the unperturbed ionosphere on the noise immunity of receiving devices of the SNS radio systems in order to obtain a functional dependence of the magnitude of Roche on a number of independent variables: frequency parameters of transmitted signals and physical parameters of the ionosphere.

3. Determination of the intervals of possible increments of the physical parameters of the ionosphere under the influence of various disturbing factors.

4. The prediction itself, i.e. calculation of the value of the Rosh at the specified values of the parameters of transmitted signals and physical parameters of the disturbed ionosphere.

The implementation of each of these steps may be difficult.

The main difficulties of the first stage of the research are that on the basis of elementary ideas about the distribution of electron concentration in the disturbed ionosphere, a qualitative analysis of the influence of the factors of trans-ionospheric RRV on the reduction of noise immunity of the reception devices of the SNS radio systems is carried out within the STS and show that the scattering factor on the

In the second stage of research, the difficulty lies in the fact that the objectives and scientific and methodological apparatus of the research conducted within the framework of the statistical theory of communication and statistical Radiophysics are loosely interconnected. Communicators consider the environment RWP as a "black box" and consider only its transfer characteristics with the original data for the solution of its main tasks: analyzing the impact of the environment RWP on the noise immunity of receiving devices of radio systems, a predetermined signal processing, synthesis of optimal for the given conditions of RWP circuits signal processing. Radiophysicists are interested only in what is happening inside the "black box", i.e., the way in which the environment affects the RWP.

It should be noted that in the implementation of this stage of research there is another difficulty, which is associated with the accuracy of the mathematical description (model) of the propagation of electron concentration (EC) in the ionosphere. On the one hand, it seems obvious that a more accurate ionospheric model will improve the reliability of the received SNS noise estimates. On the other hand, the excessive complexity of the EC distribution model in the ionosphere will require the use of more

labor-intensive methods of calculating the field characteristics of the received wave and assessing the receiver noise immunity.

The most important, but at the same time the least studied, are the questions of the third stage of research. In General, the problem of this stage should be considered as a part of the actual scientific problem of the development of models for the distribution of EC in the ionospheric part of The earth's atmosphere, exposed to various factors of natural and artificial disturbance.

In accordance with the above, it is proposed that, as a first private stage in the development of disturbed ionospheric models, measurements should be made to determine the qualitative nature of these models. These include, first of all, the type of dependence of the spectrum of fluctuations of the EC on their spatial frequency and the indicator of this dependence, the external and internal scales of ionospheric inhomogeneities and, possibly, the speed of their movement. If the results of these measurements show that the qualitative nature of the disturbed ionospheric models is the same as that of the unperturbed ionosphere, then the second particular stage requires finding out the quantitative differences of these models. This requires a:

- measurements of the possible increment intervals of the average ionosphere EC and the intensity of its inhomogeneities (and in some cases – and the speed of their changes over time) under the influence of various disturbing factors;
- to clarify the results obtained in the previous stages of the development of disturbed ionospheric models by taking into account the most significant geophysical and geographical changes in the EC;
- to develop the theoretical foundations of physical education and the development of ionospheric inhomogeneities under the influence of disturbing factors.

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**Аннотация.** В данной статье доказано, что разработка методов оценки влияния ненарушенной ионосферы на рецепторы интерференционного радио SNS позволит существенно улучшить достижение исследовательских задач учебных пособий по созданию моделей.

**Ключевые слова:** спутниковые навигационные системы, ионосфера, транс-ионосферные каналы передачи данных, полоса когерентности, помехоустойчивость.

**Summary.** It is proved in this article that development of methods of assessing the impact of the undisturbed ionosphere on the interference immunity receptors of the SNS radio will significantly improve the targeting of research problems of model creation TUTORIALS.

**Keywords:** satellite navigation systems, perturbed ionosphere, trans-ionospheric data transmission channels, coherence band, noise immunity.

UDC 681.5

## **THE APPLICATION OF RADIO OVER FIBER STRUCTURES FOR WIRELESS TELECOMMUNICATION SYSTEMS**

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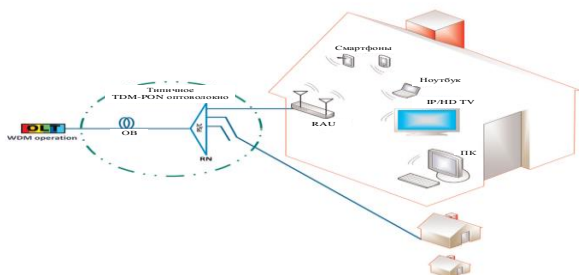
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**Main part.** Today, the technology of RoF (Radio over Fiber) is actively are enter into the microwave engineering. The new idea about convergence of PON/RoF (picture 1) consists in transfer subcarrier on the fiber PON (passive optical networks) installation. This allows data stream in baseband and RF-modulated signal to get in wire to the line and users of a wireless communication at the same time.



Picture 1 – Combining PON and RoF systems

RoF technology has shown great potential for the application of future networks of broadband wireless access because of its easy integration, sufficient optical fiber bandwidth and high mobility of wireless radio communications. In recent years, PON have become universal [1]. Telecom operators are investing significant resources to the development of PON to meet the high power requirements. For satisfaction requirements of modern networks, it is available Bidirectional RoF-PON wireless Multi Input Multi Output (MIMO) technology, which is compatible with the RoF optical networks. Picture 2 shows the architecture of the WiFi-RoF network for internal localization.



Picture 2 – WiFi-RoF network architecture for internal localization

The network topology of this architecture is represented in the form of a star with adjacent remote antenna unit (RAU) connected to a common control station through optical fibers [2].

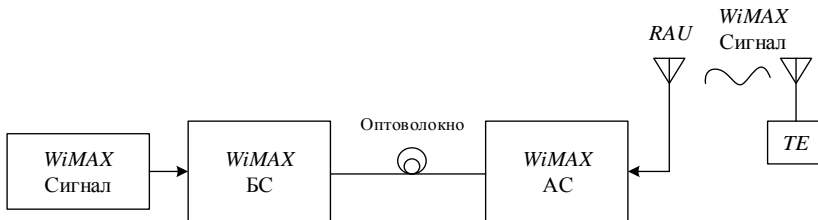
All RAU's can hang from the ceiling of each room. The RoF network is transparent to any radio signal which modulates the laser diode at the control station and reproduced on the photodiode in the RAU, then the modulation and complexity processing moves to control station, simplifying RAU. The traditional systems of internal localization assume to use infrastructure of wireless local network. The traditional network of Wi-Fi architecture the access point was deployed in one room, and the signal can cover a wide range of areas, especially in more than one room. Thus, attenuation of walls and floors must be considered inevitably in models of

wireless radio communication rooms. When electromagnetic wave propagates and collides with objects, such as walls and floors, then there are reflections, diffraction and dispersion. The signal power level depends not only on distance, but also on hindrances between the transmitter and receiver. Also, the effect of multibeam distribution will also influence on it. Thus, it is necessary to reduce destabilizing factors as much as possible. To deploying WiFi-RoF network architecture, one RAU can hang from a ceiling in each room. Besides, in this case there are no walls and floors between the transmitter and receiver. Thus, for networks based on WiFi-RoF architecture the attenuation created by walls and floors shouldn't be considered in model of wireless distribution.

The RoF system consists of four parts:

- CS (Central Station);
- BS (Base station);
- optical fiber;
- SS (subscriber station).

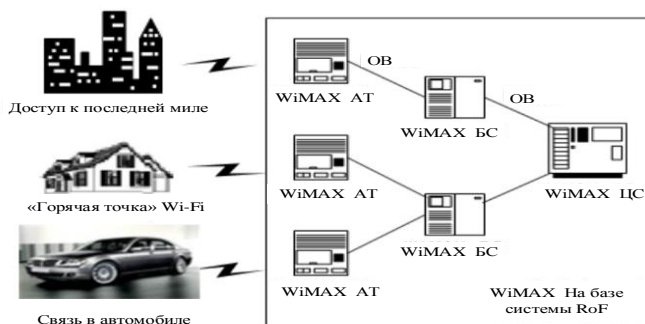
CS modulates the baseband signal of the radio frequency subcarrier and transmits modulated optical signal over the fiber and resumes the radio signal at the end of receiver. The WiMAX system consists of BS and SS which have the same function, as CS and BS in the RoF system. In the WiMAX system the high-frequency signal was transmitted on fiber between BS and SS where functions of signal processing and management are complete in BS, and the SS carries out only receiving and transmitting of radio signal and transformation between optical and electric signals so the SS doesn't assume responsibility for modulation and demodulation of a signal. Using RoF, the SS structure is simplified, and the design of a communication network becomes flexible. The schematic diagram is shown at picture 3.



Picture 3 – Schematic diagram integrated system *WiMAX* и *RoF*

There are a number of RoF application in the WiMAX systems, such as access to the last mile, access to hot spots, a car communication system, and so on (picture 4) [3].

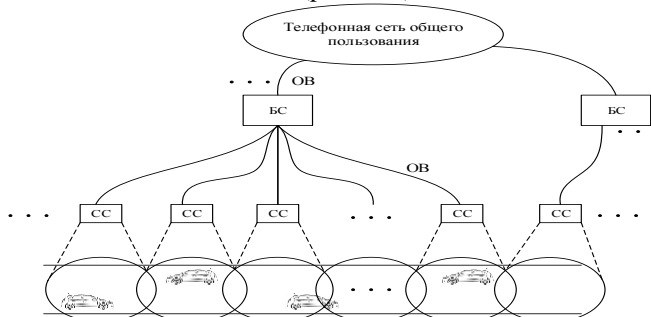




Picture 4 – RoF-based WiMAX system

Fiber to the Home (FTTH) is an important method for providing access to the last mile, but the progress of its development is rather slow. The combination of RoF and WiMAX takes advantage with large capacity and the high data bitrate, and the lowers system cost. It is a good method of access to the last mile with the high of price and quality ratio.

The WiMAX system based on RoF has a broad use and intellectual network access. The combination of WiMAX and RoF is an important addition to the current mobile communication and is used for ensuring coverage of hot spots in business centers, the airports and buildings for granting to users audio, video and service of data transmission with high quality. WiMAX can provide to low-speed moving users high-quality data and multimedia services from RoF (picture 5).



Picture 5 – The WiMAX System based on RoF used for communication with the cars

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**Аннотация.** Проведен анализ беспроводных телекоммуникационных сетей на основе структур радиосвязи по волокну (RoF). Рассматриваемые сети представляют собой сочетание технологий Wi - Fi или WiMAX и RoF.

**Ключевые слова:** радио по волокну (RoF), Wi-Fi, MIMO, WiMAX.

**Summary.** A wireless telecommunication networks based on *Radio over Fiber (RoF)* structures are analyzed. The networks considered are the combination of *Wi-Fi* or *WiMAX* and *RoF* technologies.

**Keywords:** Radio over Fiber (RoF), Wi-Fi, MIMO, WiMAX.

UDC 53.083

## **QUALITY CONTROL DEVICE OF FILM PROTECTIVE COATINGS OF PRINTED BOARDS USED IN RADIO ELECTRONICS**

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Nowadays the broad application of printed circuit boards of the modern radio-electronic equipment various protective film coverings (silicone, acrylic, polyurethane) finds in manufacturing techniques. Rapid development of electronics imposes increased requirements to their reliability and quality. The reliability of electronic means laid at the design stage and provides at the production stage [1, p.266]. Control at all his stages is an important component of any technological process. At initial stages, timely detection of defects will allow lowering the expenses connected with repair and production of defective products [2, p.216]. It is necessary to develop a device of automatic quality control of protective films on the basis of the microcontroller (microprocessor) to ensure reliability of radio-electronic equipment during exploitation [3, p. 21].

A description of such device is given in this work. It allows to conduct dynamic quality control of films and to compare various films at the choice of technology of coating.

Strict requirements are set up to protective films of printed circuit boards of the radio-electronic equipment by criteria of reliability and technological effectiveness.

Existence of structural defects in the form of through pores in protective coating explains the mechanisms of refusals [4, p. 108]. These defects are connected with such dangerous processes as chemical and electrochemical corrosion of the carrying-out and resistive elements, decline in quality of isolation of dielectric coverings, a leakage of moisture and emergence of currents of leaks [5, p. 20].

The method of visualization and determination of density of defects which has gained distribution in practice by means of anode processing or an electrophoresis – dressing doesn't allow to carry out quickly assessment of quality of protective films and to quantitatively compare different types of varnish protection [6, p.567]. As a result of use made this method, locations of defects on protective coatings of printed circuit boards are painted in other color, and places of defects are defined by the operator. Control by the operator possesses a number of shortcomings – the subjectivity and low reliability, which is characterized by low productivity on difficult products, distinguishes him impossibility to exercise 100% control of all released printed circuit boards.

The block diagram of the device was offered for elimination of shortcomings of the existing methods of quality control of a covering of protective films. This device allows solving the specified problems with control method of dynamics of volt-ampere characteristics of "the printed circuit board-electrolyte-a protective film". The schematic diagram of the device is presented in fig. 1.

As the control unit the microcontroller of the AVR ATmega 8 [7] family which is the core of device since by means of a number of peripheral devices provides the solution of a wide range of tasks is used, namely:

- registration of output volt-ampere characteristics of the specified system;
- control of the powerful pulse power supply unit on the set algorithm;
- display of experimental data to the indication device;
- saving the results of an experiment under the SPI protocol in memory like EEPROM;
- data transmission of an experiment under the RS232 protocol on the computer.

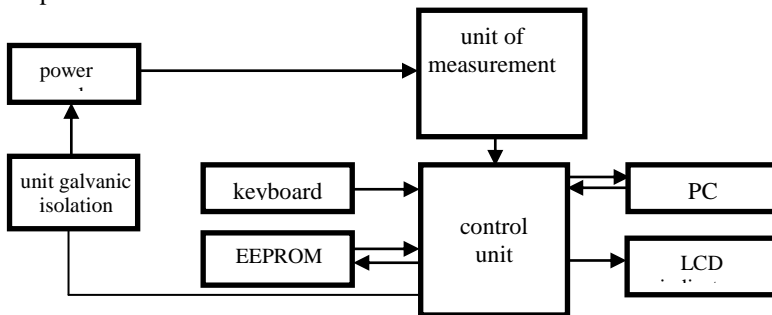


Figure 1 — the block diagram of the device

The pulse power supply unit is executed on the basis of TOP247Y chip that allows to receive big output power at small dimensions.

The measuring block includes measuring installation: printed circuit board, electrolyte and electrodes. The galvanic isolation is intended for signal transmission, for contactless management and for protection of the equipment and people against defeat by electric current.

EEPROM – is non-volatile memory which stores statistical data.

The personal computer is necessary for processing obtained yielded and the analysis of results of an experiment. The offered scheme of the device gives the chance to exclude influence of resistance of electrolyte and to provide high uniformity of distribution of tension on the surface of the printed circuit board.

The relevance of this topic is that, the presented device allows to simplify significantly process of measurement and to automate a set of statistical data on dynamics volt-ampere characteristics.

The novelty of the proposed scheme is the introduction of a microcontroller into a device for control film quality.

Practical application of this device allows quickly controlling quality protective film and comparing among themselves the coverings of various chemical composition received on different technology.

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**Аннотация:** В статье представлено описание установки автоматизированного контроля качества защитных изолирующих пленок на поверхности печатных плат. Установка основывается на динамике вольт-амперных характеристик системы «печатная плата-электролит-защитная плёнка».

**Ключевые слова:** печатная плата, микроконтроллер, защитная плёнка, вольт-амперная характеристика, электролит.

**Summary:** Article presents the description of the installation of automated quality control of the protective insulating film on the surface of the printed circuit board. Installation bases on the dynamics of the current-voltage characteristics (I-V) system "printed circuit board-electrolyte-protective film".

**Key words:** the printed circuit, microprocessor, the protective film, the current-voltage characteristics, electrolyte.

UDC 621.3

## **THE USE OF RECLOSERS FOR RELIABILITY ENHANCEMENT OF CONSUMER ELECTRIC POWER SUPPLY**

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Energetics is the key branch of the country, which determines the rate of its further development. The requirements to improve the reliability and energy efficiency of the industry, as well as its compliance with modern technologies have forced many developed countries to implement the concept of smart development entitled the 'Smart Grid'.

In Russia, the idea of Smart Grid acts as a concept of an intelligent active and adaptive network, which can be characterized by the following features [1, p. 4]:

- network saturation with active elements, allowing to change topological parameters of the network;
- a large number of sensors that measure the current operating parameters for assessing the state of the network in various modes of operation of the power system;
- data collection and processing system (software and hardware complexes), as well as controls for active network elements and electrical installations of consumers;
- availability of necessary executive bodies and mechanisms that allow real time changing of network topological parameters, as well as interacting with adjacent energy facilities;
- means of automatic assessment of the current situation and creation of network operation forecasts;
- high speed of the control system and information exchange.

On the basis of these characteristics, it is possible to give a fairly clear definition of an intelligent network as a set of software and hardware devices connected to generating sources and electrical installations of consumers, as well as information, analytical and control systems that

provide reliable and high-quality transmission of electrical energy from source to receiver at the right time and necessary quantity.

In Russia, the total length of electrical networks of all voltage classes is about 2.5 million km, of which almost half are overhead power transmission lines (OHPTL) with a voltage of 6-10 kV. Since OHPTL is the last step in the way of electric power to the consumer, the continuity of power supply is largely determined by the reliability of the operation of these networks. And the latter, for a number of reasons, is relatively low - the greatest number of emergency shutdowns falls on the 6-10 kV overhead line. At the same time, the situation is aggravated by a high degree of equipment wear - on average, 55-65% of the total number of networks of this voltage class in Russia has worked out a regulatory resource.

Today, traditional electromechanical relays are mainly used as protection devices on power transmission lines. In the event of an accident in any area, consumers are disconnected from the line along its entire length and, as a rule, for a long time. In order to restore power supply to undamaged sections of the line, the field service team is required, which allocates the damaged section of the network by successive moves and manual switching of equipment. There is also a way to control the disconnectors or the sectionalizing points with remote control from the control room. A distinctive feature of these variants is the dependence of the operation of sectional devices (disconnectors, sectionalizing points) on the decisions of the controller.

The most effective way to improve the reliability of electrical power supply in air distribution networks is the implementation of a decentralized approach. The basis of this principle is that the air line by installing of several reclosers is divided into several sections [2, p. 6].

Each separate sectionalizing device is an intelligent device capable of analyzing network parameters and automatic localizing the fault location and restoring power supply to consumers of undamaged network sections according to a pre-programmed algorithm. In the microprocessor control box, information on the line fault is processed. Thus, the localization of damage is decentralized. Only a certain section of the network becomes disabled, thereby reducing the number of those consumers, which can suffer from damage.

The vacuum recloser is a combination of a vacuum switching module, an integrated system for currents and voltages measuring, and a control box with a microprocessor-based relay protection system. It performs prompt switching in the distribution network, automatic repeated switching of the line, automatically isolates and deactivates the damaged section, automatically restores the power of undamaged network sections (ALT),

automatically collects, processes and transmits information about the parameters of network operation modes and the state of its own elements [3, p. 15].

In the case of a one-way power line sectionalization, there is no network reserve. Reclosers are installed on the main section. In case of damage, the closest recloser disconnects the subordinate part of the network. This increases the reliability of power supply to consumers located near the power center. For sectionalization of the radial line with two-way power supply, in addition to the reclosers on the highway, a recloser is installed as an ALT point, voltage control is carried out at this point, and directed defenses are used. If a fault occurs on any part of the network, it will be limited to the two nearest devices, thereby allowing consumers of undamaged areas to maintain their power. Such a scheme provides a high degree of reliability of power supply to consumers of the entire feeder. An example of the use of reclosers in a two-way power line is shown in Fig. 1.

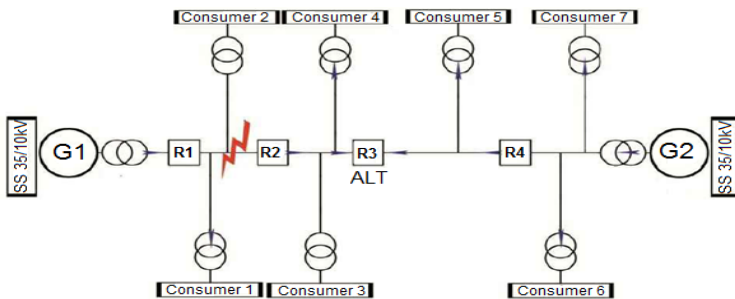


Fig. 1 Application of reclosers in a line with two-way power supply

If there is a fault in the feeder sections, the closest damage to the area is automatically disconnected - R1. Upon the disappearance of the voltage, R3 is automatically turned on. The switch-on is short-circuited, and the faulty part is cut off by R2 (reverse power direction). Disconnection occurs selectively, R3 remains in the on position, thereby automatically isolating the damaged area and restoring the power to the intact consumers in the line segment from R3 to R2. The effectiveness of this scheme of installation of reclosers is due to the ability to automatically localize the damage within one site and automatically provide backup power for consumers outside the damaged area.

The second option for setting up the reclosers: R1 is disconnected in SC (short circuit), then P2 is switched off by undervoltage seal-in, when power is restored from R3 to ALT (Automatic load transfer), the power supply of consumers 3 and 4 is restored [4, p. 134].



At present intellectualization of distribution networks in Russia is carried out within the framework of pilot projects. On the basis of two districts of the Kaliningrad region - Mamonovsky and Bagrationovsky - a system of distributed automation of networks was created. The existing network has integrated "smart" devices - reclosers, which allow without the participation of operational personnel to automatically find and allocate the damaged site, while maintaining the power supply of the main part of consumers. Before the project was launched, the field service team made more than 5 trips per day to find and eliminate the violation on the line. All operations were performed by power engineers manually; constant communication with the dispatcher was maintained. Time of search and localization of damage was more than 6 hours. Now the field service team's departure is performed once a day to eliminate damage, the elimination time was reduced to 49 minutes. Thus, the time for consumers to de-energize in 6 (10) kV networks was reduced by more than 5 times. And if earlier 20-30 transformer substations were switched off during the accident, power supply was broken up to 3000 thousand people, now up to 10 transformer substations and a maximum of 900 inhabitants are de-energized [5, p. 188].

The economic efficiency of the use of reclosers in each specific project depends on a number of factors: the length of the line, the specific number of network failures, the type of switching equipment, the average cost of restoring one sustained damage, the specific damage from the unpermitted electric power to consumers.

The use of reclosers makes it possible to reduce the time of restoration of power supply, reduce the frequency of damage to the line and, accordingly, the volume of repair work. So, the technical effect should be attributed to minimizing the idle time of transformers, and much more efficient use of network bandwidth, and improving the reliability of electricity supply to consumers.

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**Аннотация.** В данной работе проведен анализ отечественных электрических сетей, на основании которого выявлены наиболее уязвимые участки и сформулированы основные проблемы распределительных сетей. Предложен вариант их устранения и повышения надежности электроснабжения потребителей. Решение проблемы базируется на применение реклоузеров, что позволит не только повысить надежность и энергоэффективность, но и станет фундаментом для дальнейшей интеллектуализации электрических сетей. Выполнена оценка целесообразности и возможности инновационного развития отечественных распределительных сетей.

**Ключевые слова:** электрические сети, надежность электроснабжения, реклоузер, интеллектуальные сети, Smart Grid.

**Summary.** In this paper, the analysis of domestic electric grids was conducted, on the basis of which the most vulnerable areas were identified and the main problems of distribution networks were formulated. The variant of their elimination and increase of reliability of power supply of consumers is offered. The solution of the problem is based on the use of reclosers, which will not only increase reliability and energy efficiency, but will also become the basis for further intellectualization of electrical networks. The feasibility and possibilities of innovative development of domestic distribution networks were assessed.

**Key words:** Electrical networks, power supply reliability, recloser, intelligent networks, Smart Grid.

UDC 621.3

## **ELECTRIC POWER SYSTEM CALCULATION FEATURES OF JACK-UP FLOATING DRILLING RIG**

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The purpose of the article is to develop elements of the methodology for designing the electric power system (EPS) of a jack-up floating drilling rig (JFDR). To solve this problem, it is necessary to determine the difference between the ship's power plant and the EPS of JFDR.

Consider the EES of a refrigerated vessel. The main load on this type of vessel is the refrigeration system [1, p. 65], the operation of which should be provided in any mode of operation of the power plant, including emergency operation. At the same time, the capacities of such installations allow the use of standard voltage levels of 380 and 220 V [1, p. 19].

In the case of the JFDR, the main load is the drilling mechanisms, such as the drilling pump and the top drive. The power capacity of these mechanisms is quite large and the use of a standard voltage level of 380 V would lead to an inappropriate increase in the cross-section of power cables [2, p. 28], so the following voltage level is used: 660 V.

The scheme of power generation of a refrigerator vessel is as follows: the main generators with a voltage of 400 V transmit electricity to the main switchboard 380 V, from which the electric power through the transformers is transmitted to the main switchboard of 220 V and through the jumper to the emergency switchboard of 380 V.

Unlike the scheme of the refrigerator ship, the generating circuit of the JFDR due to the 660 V switchboard will be more branched: the main generators with a voltage of 690 V transmit electricity to the main switchboard of 660 V, from which the electric power through the transformers is transferred to the main switchboard of 380 V, and even from the main switchboard of 380 V via transformers on the main switchboard of 220 V and through the jumper on the emergency switchboard of 380 V, which receives power from emergency generator in emergency modes. From the emergency switchboard of 380 V, in its turn, through the transformers receives power emergency switchboard of 220 V. In addition, from the main switchboard of 380 V directly through the two jumpers is supplied switchboard of the harbour generators, which receives power from two harbour generators. The scheme of power generation of the JFDR is shown in Figure 1.

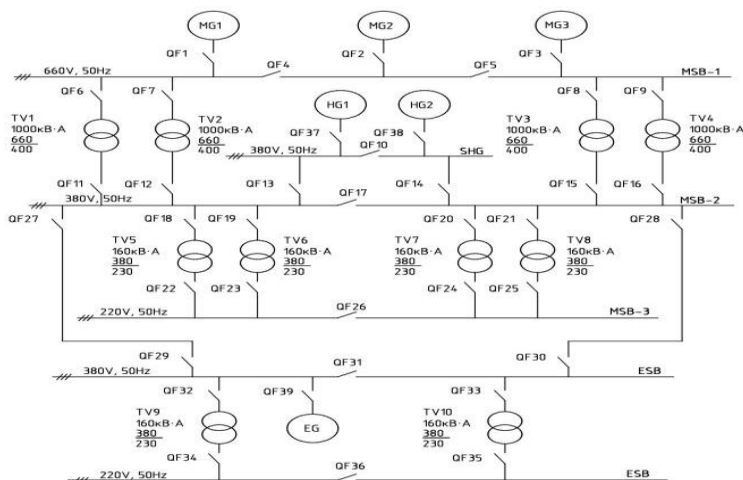


Figure 1 – The scheme of power generation of the JFDR

The procedure of scheme development is as follows:

- 1) the selection of the type of current;
- 2) selection of voltage levels;
- 3) the selection of the number of generators;
- 4) selection of switchboards;
- 5) selection of transformers.

When choosing the parameters of the power generation scheme, one should be guided by common sense, economic parameters [3, p. 41], experience in developing similar projects and normative documentation. The main normative document is the "Rules for the Classification, Construction and Equipment of Floating Drilling Units and Marine Stationary Platforms" of the Russian Maritime Register of Shipping (RMRS) [4].

As the main consumers on the JFDR are asynchronous motors, the chosen type of current is a variable one.

Taking into account the presence of both powerful drives of drilling equipment, and standard consumers like fans, heaters and lighting, the following voltage levels will be required: 660 V, 380 V and 220 V [4, p. 137].

The JFDR works in such modes as "Drilling", "Port Staying", "Emergency" and others, therefore, in addition to the main generators, it is also necessary to use harbour and emergency ones. Power from the main generators in the mode of "Port Staying" is impossible, since they have more power and will be underloaded due to the small energy costs of the

harbour regime. To increase the reliability, you must install 3 main generators, as well as 2 harbour and one emergency.

The main generators must supply the shield with the highest voltage level [5, p. 356], therefore they supply the main switchboard-1 with a voltage of 660 V. The harbour generators supply the 380 V power supply panel (switchboard of the harbour generators), which in turn receives the main power switchboard-2 with a voltage of 380 V. The main switchboard-2 transmits power to the switchboard-3 with a voltage of 220 V. The emergency switchboard of 380V receives power from the emergency generator and supplies by itself the emergency switchboard with a voltage of 220 V. Thus, all necessary consumers will be energized in all operating modes.

Transformers are used to transfer electricity between switchboards [6, p. 677]. According to the rules of RMRS it is necessary to install backup transformers in addition to the main ones to improve the reliability of power supply. Due to the high power transmitted between the switchboards of the main switchboard-1, the main switchboard-2 and the main switchboard-3, two primary and two reserve transformers must be installed between them. Between the 380 V and 220 V emergency switchboards, it is sufficient to install one main transformer and one backup transformer.

After carrying out such a sequence of components selection, the power generation schemet will be as in Figure 1.

The methodology for calculating the EPS of a refrigerator vessel for most items can be applied for the calculation of the EPS of JFDR, taking into account the RMRS requirements for drilling rigs. The developed scheme for generating a jack-up floating drilling rig is successfully used in engineering design.

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**Аннотация.** В статье рассматривается методика проектирования электроэнергетической системы самоподъемной плавучей буровой установки. Проведен сравнительный анализ электроэнергетических систем рефрижераторного судна и самоподъемной плавучей буровой установки. Методика расчета системы генерирования электроэнергии рефрижераторного судна может быть применена к самоподъемной плавучей буровой установке с учетом использования повышенного напряжения для питания. Разработанная схема генерирования самоподъемной плавучей буровой установки успешно используется в инженерном проектировании.

**Ключевые слова:** самоподъемная плавучая буровая установка, электроэнергетическая система, методика проектирования, особенности применения.

**Summary.** The design technique of the electric power system of a jack-up floating drilling rig is considered in the article. A comparative analysis of the electric power systems of a refrigerator ship and a jack-up floating drilling rig is carried out. The methodology of the power generation system calculation of a refrigerated ship can be applied to a jack-up floating drilling rig, taking into account the use of increased voltage for power. The developed scheme for generating a jack-up floating drilling rig is successfully used in engineering design.

**Key words:** Jack-up floating drilling rig, electric power system, design technique, application features.

**ENGINE WATER INJECTION SYSTEM****Anton Farniev**

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Nowadays many automakers are trying to improve the fuel efficiency and emissions reduction. Even the highly developed modern internal combustion engine uses the fuel-air mixture not efficient enough. The combustion efficiency of the fuel-air mixture depends on temperature conditions in the combustion chamber. The better temperature conditions for air-fuel mixture can be achieved by using water injection system.

Water injection, also known as anti-detonant injection (ADI), can spray water into the incoming air or fuel-air mixture, or directly into the cylinder to cool certain parts of the induction system where "hot points" could produce premature ignition. The decrease in temperature makes it possible to use high compression ratios without the risk of knock. The higher compression ratio improves the fuel economy and power of the engine.

Water is one of the naturally existing substances with a high capacity of heat absorption (approximately 2260 kJ/kg). As the ambient temperature water is injected into the engine, heat transfers from the hot cylinder head and intake air into the water. This makes it evaporate, cooling the intake charge. A cooler intake charge means it is more dense (higher volumetric efficiency) and has a lower tendency to knock. However, the water vapor displaces some air, negating some of the denser intake charge benefit. Knocking is generally more of a problem in forced induction engines rather than naturally aspirated, so this can help prevent it. On electronic ignition

systems, the ignition timing is generally retarded to prevent knock from occurring but with water injection it can be advanced closer to maximum brake torque (MBT) timing for additional power.

The company Bosch recently introduced its water injection system for internal combustion engine named “WaterBoost”. The system isn’t as complex as it might initially sound. In this system, the water injectors are attached to the water rail, which provides water to the injectors. Besides these two main components, the system also includes a water pump, electronic pump control unit, engine control unit and 1.3-gallon frost-proof tank located in the trunk. The components are maintenance-free but the tank needs to be topped up occasionally. The engine still runs if the tank is empty, though it generates less power and it emits more CO<sub>2</sub> [3].

According to Bosch, running a higher compression ratio makes for improved performance and around 4 percent less CO<sub>2</sub> under test conditions. In the real world, the company says fuel savings could be up to 13 percent. Bosch says manufacturers can expect a 5 percent boost in horsepower without any increase in displacement. Although there are big potential benefits, the water injection system is reasonably simple in its operation. Water is drawn from a small tank, and a fine mist is sprayed directly into the intake port, where it evaporates. Bosch says 5 liters (1.32 gal) of demineralized water is enough to last around 3000 km (1864 mi) of regular driving, and when it runs dry the car will carry on operating as normal [2].

The advantages of the water injection system: possibility to increase the compression ratio that improve the fuel efficiency and increase the power of engine, emissions reduction, cooling the pistons and the walls of the combustion chamber that increases their durability.

The disadvantages of the water injection system: the need for additional equipment, changes in the design of cylinder head for installing the water injectors, the need to refill the water tank.

Nowadays automobile manufacturers are developing new complex systems to improve the internal combustion engine characteristics. The water injector system is not complex enough to be installed in the internal combustion engine, but at the same time it’s one of the solution of fuel economy and environment protection. This system has already installed in some concept cars such as BMW M4 GTS and it will probably be installing in serial automobiles in near future.

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**Аннотация.** В данной статье приведена технология системы впрыска мелкой дисперсии воды во впускной тракт бензинового двигателя, рассмотрено ее практическое значение и влияние на характеристики двигателя, а также улучшение экологических параметров двигателя с использованием данной системы. В качестве примера использования системы впрыска водяной дисперсии представлена и рассмотрена система BOSCH WaterBoost, которая может устанавливаться в качестве дополнительной системы на уже существующие двигатели, тем самым повышая его характеристики и уменьшая вредные выбросы в атмосферу.

**Ключевые слова:** системы впрыска воды, BOSCH WaterBoost, впрыск воды.

**Summary.** Nowadays many automakers are trying to improve the efficiency of internal combustion engine, developing complex system. They are trying to reduce emissions and improve the fuel economy without power loss. These problems can be solved with a help of water injection system. The water injection system spray water into the cylinder lowering the temperature within the combustion chamber that makes it possible to use high compression ratios without the risk of knock. The higher compression ratio improves the fuel economy and power of the engine. The company Bosch already produces such systems. According to Bosch, the water injection system reduces emissions by 4 percent and saves 13 percent of the fuel.

**Keywords:** water inject system, BOSCH WaterBoost

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#### **AN 4-6 GHz SIGE BiCMOS POWER AMPLIFIER**

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## Introduction

Power amplifier is one of the key component elements in wireless transceivers system. The performance of power amplifiers is a crucial issue for the overall performance of the transceiver's chain. The power amplifier (PA) technology has matured rapidly over recent years and has become highly integrated into several process technologies including SiGe BiCMOS, CMOS and GaAs. However, CMOS technology has the disadvantage of poor microwave performance, and GaAs-based integrated circuit are relatively expensive and difficult to be integrated with silicon-based technology. So SiGe BiCMOSs are more attractive due to their compatibility with CMOS technology for high-level integration, high thermal conductivity, lost cost and superior microwave power performance.

## Main part

The block diagram of the developed PA is shown in Figure 1. The input stage is built according to a common collector circuit to increase the input impedance of the circuit. The second and third stages of the amplifiers are built according to a common emitter circuit to provide the necessary voltage gain.

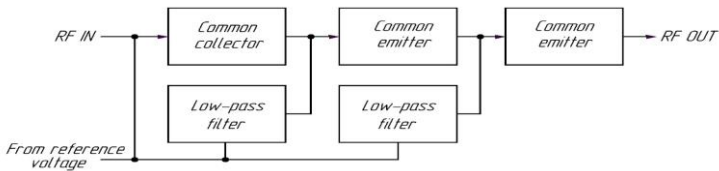


Figure 1 — The block diagram of the PA

The bias voltage of the transistors VT1, VT2 and VT3 is  $\sim 1.3$  V and is set using the reference voltage [1, p. 168]. The low-pass filters (LPFs) are necessary to stabilize the operating points of stages.

Cadence IC Design software package with 0.18  $\mu\text{m}$  SiGe BiCMOS libraries was used for the development of electrical scheme and simulation. The simplified electrical scheme of the developed PA is shown in Figure 2.

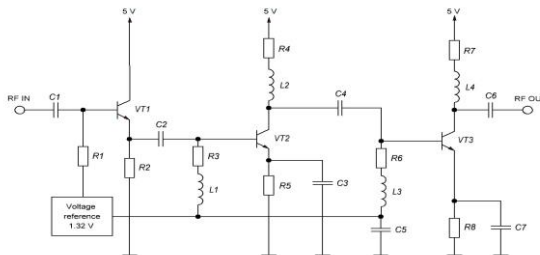


Figure 2 — The simplified electrical scheme of PA

Figure 3 shows the frequency response of the electrical circuit at three different temperatures:  $-60^{\circ}\text{C}$ ,  $27^{\circ}\text{C}$  and  $85^{\circ}\text{C}$ . The operation of the amplifier in conditions of elevated temperatures is accompanied by a decrease in the gain. It can be seen from the graphs that the spread of the gain in the operating frequency band doesn't exceed 1.8 dB.

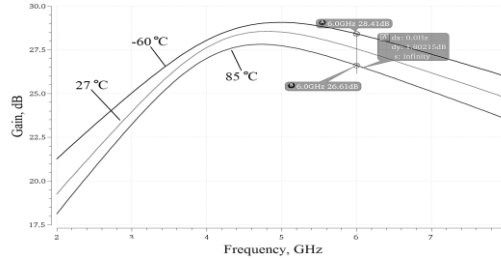


Figure 3 — Gain at various temperatures

The dependence of the maximum output power on the frequency for different temperatures is shown in Figure 4.

The total harmonic distortion, or THD, of a signal is a measurement of the harmonic distortion present and is defined as the ratio of the root mean square (RMS) of all high harmonic components to the RMS of the fundamental frequency harmonica. The dependence of the coefficient on the frequency for different temperatures is shown in Figure 5. It can be seen from the graphs that the THD doesn't exceed 3.5 % in the whole range of operating frequencies.

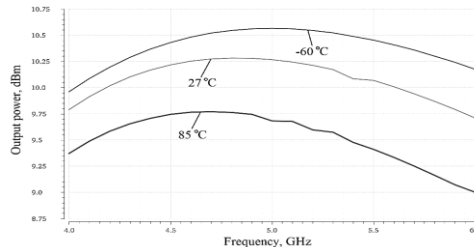


Figure 4 — Output power versus frequency at various temperatures

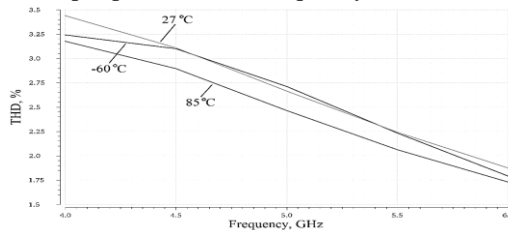


Figure 5 — Simulated THD at various temperatures

The output impedance of the developed amplifier is matched with 50 ohms. The quality of the matching can be estimated using parameter VSWR (voltage standing wave ratio). The dependence of VSWR on the frequency of the input signal of the PA at three different temperatures is shown in Figure 6.

The simulated output 1-dB compression point  $OP_{1dB}$  at 5 GHz equals 10 dBm (Figure 7).

Table 1 summarizes the performance of the presented PA, with comparison to previously published PAs.

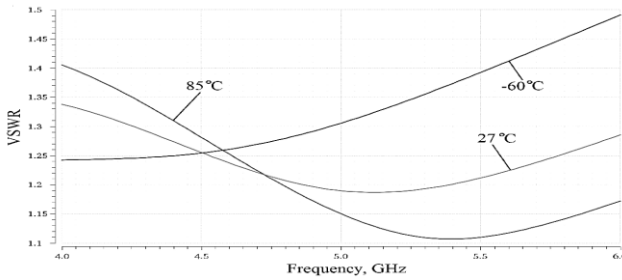


Figure 6 — Simulated VSWR at various temperatures

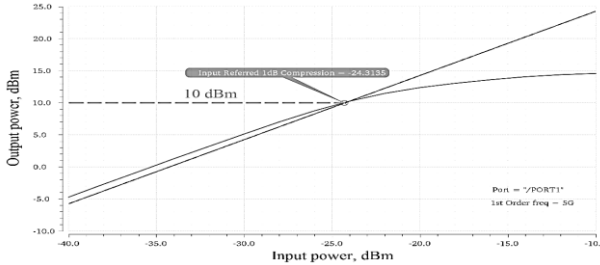


Figure 7 — Simulated output 1-dB compression point at 5 GHz

Table 1 — Comparison the presented PA with previously proposed PAs

Spec.	This work	[2]	[3]	[4]
Technology	SiGe 0.18 $\mu$ m	SiGe 0.18 $\mu$ m	SiGe 0.25 $\mu$ m	SiGe 0.25 $\mu$ m
Band, GHz	4—6	2.4—2.5	2.4	1—5
Gain, dB	27—28	29.5	23	16.5—18
PAE, %	6	—	7	—
Output power, dBm	10	13.8	21	15
$OP_{1dB}$ , dBm	10	—	20.5	13.2—14.6
Supply voltage, V	5	3.3	—	3
Power, mW	295	—	—	180

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**Аннотация.** В статье представлены результаты разработки интегрального усилителя мощности С-диапазона. Разработана электрическая схема интегрального МШУ и проведено моделирование в системе автоматизированного проектирования (САПР) *Cadence IC Design* в рамках 0,18 мкм SiGe БиКМОП технологического процесса.

Разработанная схема УМ в диапазоне частот 4-6 ГГц обеспечивает усиление 27-28 дБ. Точка децибельной компрессии по выходу не превышает 10 дБм. Коэффициент нелинейных искажений выходного сигнала во всем диапазоне рабочих частот не превышает 3,5 %. Коэффициент полезного действия не превышает 6 %. Потребляемая мощность 295 мВт от источника питания 5 В.

**Ключевые слова:** усилитель мощности, УМ, SiGe, БиКМОП, С-диапазон.

**Summary.** The article presents the results of the development of an integrated C-band power amplifier. Cadence IC Design software package with 0.18 um SiGe BiCMOS libraries was used for the development of electrical scheme and simulation.

The developed LNA scheme in the frequency range 4-6 GHz provides 27-28 dB gain. The simulated output 1-dB compression point  $OP_{1dB}$  at 5 GHz equals 10 dBm. THD of the output signal over the entire operating frequency range doesn't exceed 3.5 %. PAE does not exceed 6 %. The power consumption is 295 mW from the 5 V power supply.

**Keywords:** power amplifier, PA, SiGe, BiCMOS, C-band.

## THE LABORATORY BENCH FOR THE RESEARCH WEBCAMS

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**Main part.** The structure of the model consists of: a standart target that will be illuminated by controlled light sources (LEDs), circuits with LED control, a web camera that shoots the standart target at a specific time (makes a printscreen). The entire measuring installation is covered with a protective cover to prevent light external sources. All test images and tables are placed at a fixed distance from the video camera through the opening slot in the protective cover.

In the process of making measurements it is necessary to determine the following parameters of a digital video camera: minimum illumination (threshold sensitivity); dynamic range; the resolution of the camera; noise level.

The main elements of the projected scheme are: LEDs, transistors, ATMEGA 16 microcontroller, current sensor, buttons, LCD display, power supply

Using the buttons we can select the LEDs, its luminance level and reset. The pulse-width modulation (PWM) will control LEDs. PWM signal is a pulse signal of constant frequency, but a variable duty cycle (the ratio of the pulse duration and the time it follows). Due to the fact that most of the physical processes in nature have inertia, the sharp voltage drops from 1 to 0 will be smoothed out, taking some average value. By setting the duty cycle, you can change the average voltage at the PWM output.

PWM control signal is fed from microcontroller through RC filters, which turn it into a constant component. This constant component falls on the transistor. Transistor is slightly opened or closed, it depends on the level of the signal (current). So there is adjustment of the luminosity of the LED. The luminosity changes from 0%, the LED is completely turned off, up to 100%, the LED has the maximum luminosity, with a nonlinear step: in the range from 0% to 10%, the luminosity changes in 0.5% increments, from 10% to 20% - 1%, from 20% to 100% - 5% of the maximum luminosity.

The current sensor consists of the resistor in 1 Ohm (measuring instrument) and the operational amplifier. The sensor works as follows: on the resistor a certain tension which numerically is equal to current moves, according to the law of Ohm, further from the operational amplifier tension moves on the microcontroller. Thus not only fixing of value of current, but also its regulation is made. Data on the level of luminosity and color of the selected LED will be brought to the LDC display. As the luminosity of a LED is known and regulation is possible, this diagram provides also protection against failure of light sources.

Programming of this microcontroller will be carried out on a board of ARDUINO and in the software of FLPro.

The schematic diagram of a prototype is provided in a figure 1.

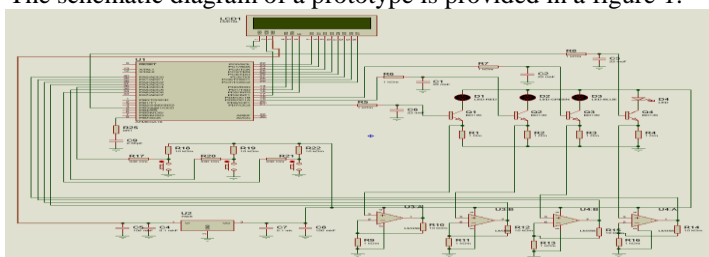


Figure 1 — Model of the modified three-frequency HF antenna

**Conclusion.** In the inference the control diagram was created by light sources. Control includes support and brightness control, with a non-linear step and also protection against fail-ure of these light sources. The non-linear step provides more exact removal of the ex-periences this in the course of carrying out.

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**Аннотация.** Студенты, изучающие радиотехнику, в ходе курса “Основы телевидения” осваивают дизайн современных цифровых веб-камер. Для изучения характеристик веб-камер нужна модель, которая должна состоять из контролируемых источников четырех цветов. Камера построена в соответствии с системой RGB и реагирует на три компонента и белый свет. Поэтому основной задачей является создание модели (цифровой схемы), в которой есть четыре контролируемых источника света. Яркость этих источников может варьироваться от нуля до максимального значения. Эти источники

света должны освещать определенную цель, которую будет снимать веб-камера.

**Ключевые слова:** управляемые источники света, веб-камера, широтно-импульсная модуляция.

**Summary.** The students, of the radio engineering, during the course of the “Fundamentals of Television” study the design of modern digital web cameras. To examine the characteristics of web cameras we need a model, which should consist of controlled sources of four colors. Because the camera is built according to the RGB system and responds to three components and white light. Therefore, the main task is to create a model (digital circuit) in which there are four controlled sources of light: red, blue, green and integral white. the brightness of this sources can vary from zero to the maximum value. These light sources should illuminate a certain target, that the web camera will shoot.

**Keywords:** controlled light sources, webcam, Pulse width modulation.

UDC621.86

## **EXOSKELETONS AND PROSPECTS OF THEIR USE**

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Modern technologies significantly expand the boundaries of human capabilities. Exoskeletons have always been and still remain one of the most promising and ambitious technologies in this regard. With their help people can restore their physical abilities, that were lost, or even acquire the new ones. The relevance of exoskeletons is due to the fact that they are used in many areas of science and technology, moreover there are quite interesting principles of their application in medicine and in armament of countries. In future exoskeletons may become an integral part of our life.

Exoskeleton is the newest unique development of scientists in such an area of science as biomechanics. The technology is made in the form of an external frame system, which is designed to strengthen the muscular strength of a human or an android robot. Such technology in future will



eliminate physical limitations in human life, as well as in the usage of mechanisms.

Developers of such devices work in different directions - both military and civilian. One of the main and promising developments today is the military usage of exoskeletons. The purpose of these developments is in the creation of an armor, which combines the firepower and the reserving of the tank, the mobility and speed of a man, and increases the strength of someone who uses an exoskeleton [2]. The rescue version of the suit was designed to solve several problems: the transport of extremely heavy goods for human over long distances, demining of the area, participation in antiterrorist operations, elimination of the consequences of man-made disasters and natural disasters, analysis of caving and blockages, extinguishing fires, when the air reserve in the rescuer's breathing apparatus is limited and others.

Another promising area of application of exoskeletons is helping to traumatized people and people with disabilities, the elderly, who have problems with the musculoskeletal system because of their age [3]. This will give more chances to people who are chained to a wheelchair. Biomechanics are trying to integrate such devices in the rehabilitation process. They will perform several functions simultaneously: a wheelchair substitute, a simulator for people with diseases of the musculoskeletal system; means of social and emotional rehabilitation. The owner of such equipment will be able to move independently.

Commercial and civil exoskeletons make up a smaller part of the exoskeleton industry, but they also have good commercial prospects. However, this all is still in the distant future. At the moment, commercial exoskeletons are limited in transportation, tourism assistance and prevention of sports injuries.

Despite the rapid development of modern technology, scientists are working on the creation of a convenient, functional and affordable exoskeleton, face a number of difficulties. And the most important of them is the limited action of energy carriers [1]. Even the most powerful battery is not capable to provide a long-term autonomous operation. Second serious problem that the scientists have to solve is the search of a superlight material for making the frame. Finally, the third problem is management. The difficulty lies in the fact that the exoskeleton must be simultaneously responsive, but at the same time protect the user from the difference in movements.

Exoskeletons still have much things to improve. Considering the current developments, active financing of the military sphere and the speed of development of scientific research, we can soon expect the emergence of

super suits, similar to those that we could see only in films. Undoubtedly, exoskeletons are the most complicated technologies that people have to study, but they are the future.

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**Аннотация.** Тема научной статьи – экзоскелеты и перспективы их использования, в рамках которой были рассмотрены перспективы использования экзоскелетов, а также трудности, с которыми сталкиваются ученые, работающие над созданием удобного, функционального и доступного роботизированного костюма. Был произведен анализ преимуществ и недостатков экзоскелета. Отмечено, что роботизированные костюмы необходимы в военной промышленности, в медицине, а также в коммерческих сферах.

**Ключевые слова:** биомеханика, экзоскелет, каркас, энергоноситель.

**Summary.** The theme of the scientific article is "Exoskeletons and the prospects of their use" – in which the prospects of using exoskeletons were discussed, as well as the difficulties faced by scientists working to create a convenient, functional and affordable robotic suit. The advantages and disadvantages of the exoskeleton were analyzed. It is noted that robotic suits are necessary in the military industry, in medicine, and also in commercial spheres.

**Keywords:** biomechanics, exoskeleton, frame, energy carrier.

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### INTEGRATED PHASE SHIFTER DEVELOPMENT

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**Introduction.** Taking into account the considered integral phase shifters being developed today, was decided that when developing a monolithic integrated circuit of the AESA receiving and transmitting module in SiGe technology, the phase shifter will optimally perform in the form of a vector phase shifter.

**Structural scheme.** The controlled phase shifter block scheme is shown in figure 1.

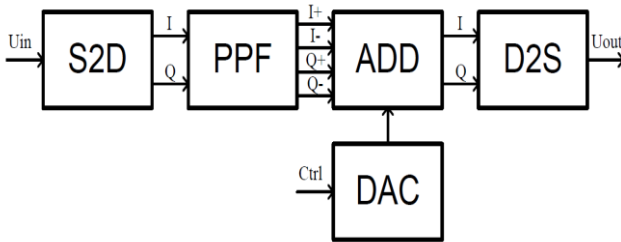


Figure 1 — Developing phase shifter structural scheme

The block diagram includes:

- balancing device (S2D converter) is a converter single-ended input signal to a symmetrical output signal;
- quadrature signal generator based on a polyphase filter (PPF);
- dual adder (ADD);
- digital to analog signals convertors scheme (DAC);
- output symmetrical (differential) signal in single ended converter (D2S converter).

**Electrical scheme.** On the base of the phase shifter structure diagram, the electrical circuits of each unit have been developed. The input asymmetric signal is converted into a symmetric signal by the input differential stage S2D converter (figure 2) based on the transistors Q0 and Q1. The input signal is going to the port IN. The output signal is removed from the OUTP and OUTN ports. Power voltage is supplied to the VDD port (GND — zero potential). The VREF port is used to supply the reference voltage generated by the reference voltage source described in [1]. Capacitors C0, C1 provide an inter-stage isolation over the DC component, since a separate bias circuit is used for the adder ADD. The feedback formed by capacitor C4 and resistor R7 in the differential stage forms the required frequency characteristics of the converter.

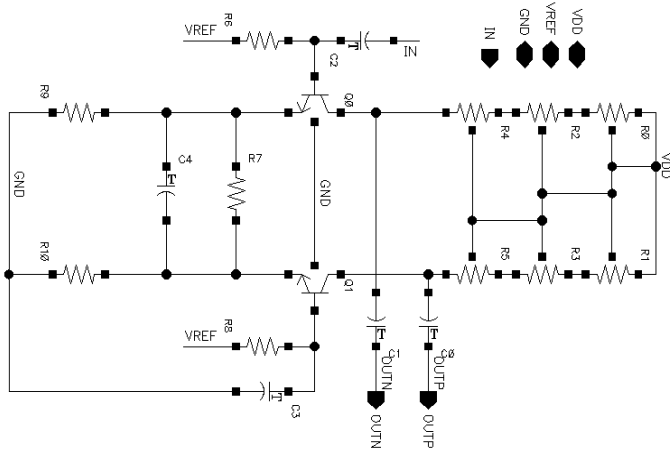


Figure 2 — S2D converter electrical scheme (clockwise rotated)

The differential signal from the output of the S2D converter is fed to the input of the quadrature signal driver (figure 3), whose circuit based on the RC-CR circuit was developed by my colleagues — engineers of the Engineering Center.

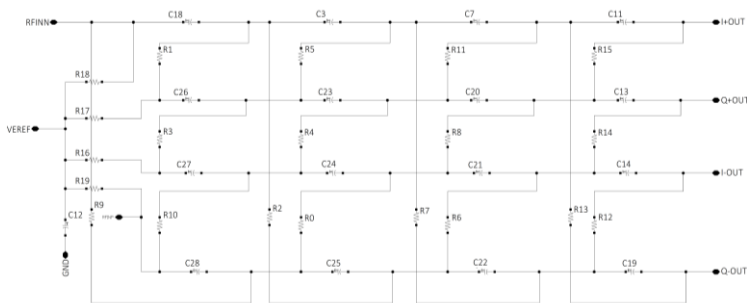


Figure 3 — PPF electrical scheme

Feeding symmetrical signals to the input of such a filter, four quadrature signals are shifted relative to each other by 90 degrees at its output. These signals are fed to the inputs of the adder signal (ADD on figure 1). The electric circuit of the adder has the form shown in figure 4.

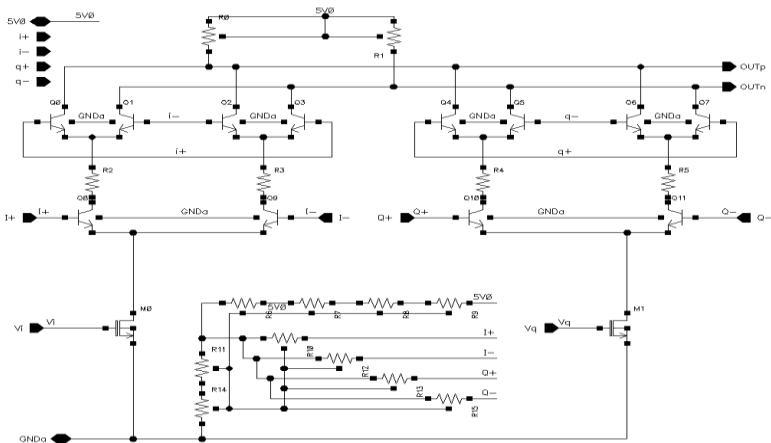


Figure 4 — Adder electrical scheme

The generation of output signals with the required phase is precisely realized by means of a double balance combiner circuit. This function block performs a weighted summation of the quadrature signals with the relative phases  $0^\circ$ ,  $90^\circ$ ,  $180^\circ$  and  $270^\circ$  applied to its inputs. As a result, the signal at the output of the adder will have a phase determined by weighted addition of the corresponding pair of signals. For example, to obtain a phase of the output signal  $135^\circ$ , it is necessary to add signals of equal amplitude with phases of  $90^\circ$  and  $180^\circ$ .

The control of the amplification of each arm, which determines the length of each vector, is carried out using a current DAC. The DAC circuit is shown in figure 5.

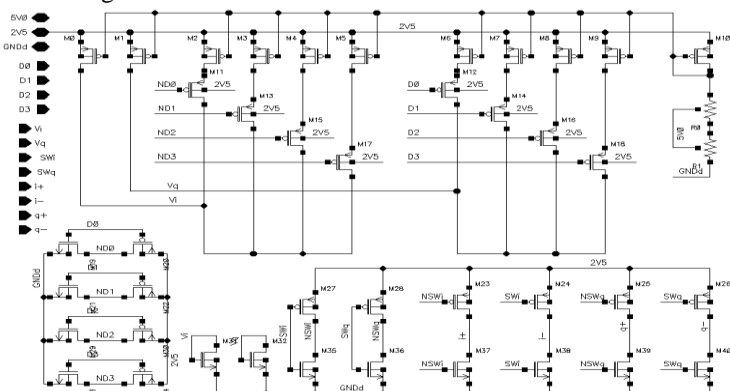
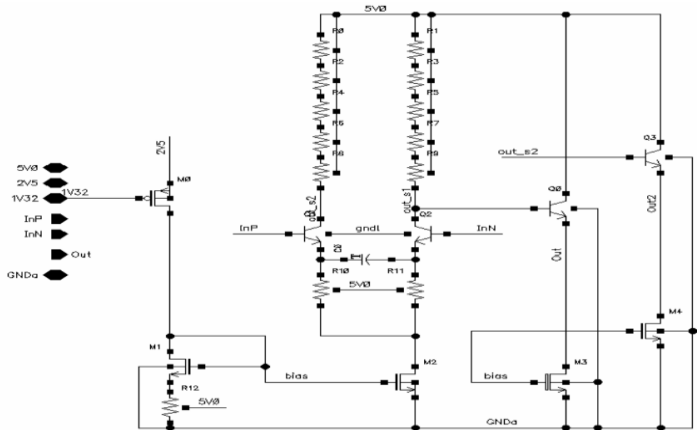


Figure 5 — Current DAC electrical scheme

The operation of the control circuit consists in generating voltages at its outputs ( $V_i$  and  $V_q$ ) when the logic levels corresponding to the phase shift of the output signal are fed to its inputs  $D0—D3$  and  $SW_i$ ,  $SW_q$ . This is realized by controlling the transistors  $M11—M18$ . Control of them corresponds to a change in the values of the currents flowing through the transistors  $M31$ ,  $M32$ , the voltage drops on which are the control voltages for the amplifiers of the adder.

The terminal block is a converter of a symmetrical signal into an asymmetric signal. The circuit (figure 6) is a differential amplifier, similar to  $S2D$ . At the same time, a symmetrical signal is applied to its input, and the output voltage is removed by means of a voltage follower from the collector of one of the amplifying transistors. As a result, this voltage is unipolar.



**Conclusion.** As a result of the development, the electrical circuit of the integral phase shifter in BiCMOS 0.18 SiGe technology with parameters was obtained:

- supply voltage 5 V;
- level of logical “0”/”1” — 0/2.5 V;
- consumption current 17 mA;
- frequency band 4—6 GHz;
- operating temperature range –60—85 °C;
- phase adjustment range 360 degrees;
- phase resolution 5.625 degrees (6 bit);
- RMS phase error in the operating frequency range 0.789 degrees;
- RMS phase error in the operating temperature range 0.929 degrees;
- minimum gain value 11.75 dB;
- RMS gain error in the operating frequency range 0.361 dB;
- RMS gain error in working temperature range 0.377 dB;
- maximum to establish a transition process time 30 ns;
- maximum phase switching time 500 ps;
- maximum harmonic distortion factor 3% (Pin = –25 dBm).

In a further time to decrease the root mean square error of establishing phase and amplitude is possible the adjustment of the adder and current DAC schemes.

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**Аннотация.** Статья посвящена разработке модуля интегрального управляемого векторного фазовращателя С-диапазона частот. Этот модуль является одним из функциональных блоков разрабатываемой монолитной интегральной схемы приемо-передающего модуля активной фазированной антенной решетки Инжиниринговым центром СевГУ в рамках государственного задания. Технологический процесс – БиКМОП 0,18 мкм SiGe.

Разрабатываемый ФВ управляется шестиразрядным цифровым кодом и может установить фазу выходного сигнала в диапазоне 360 градусов с шагом 5,625 градуса. Среднеквадратические ошибки установления фазы и амплитуды не превышают 1 градус и 0,5 дБ, соответственно. С учетом того, что максимальная ошибка

установления фазы не превышает 2,5 градусов, возможно использования такого ФВ в системе формирования диаграммы направленности антенн с количеством излучателей не менее 64.

**Ключевые слова:** интегральная схема, приемо-передающий модуль ФАР, С-диапазон, фазовращатель, АФАР, БиКМОП, кремний-германиевая технология.

**Summary.** The article is devoted to the development of the integral controlled vector phase shifter C-band module. This module is one of the functional blocks of the developed monolithic integrated circuit (chip) of the receiving and transmitting module of the active electronically scanned antenna. This chip is developed by Sevastopol state university Engineering centre in the state assignment framework. Technological process is SiGe BiCMOS 0.18  $\mu\text{m}$ .

The developed phase shifter is controlled by a six-digit code and can set the phase of the output signal in the range of 360 degrees in increments of 5,625 degrees. The root mean square error of establishing phase and amplitude do not exceed 1 degree and 0.5 dB, respectively. Taking into account the fact that the maximum absolute error of phase setting does not exceed 2.5 degrees, it is possible to use such phase shifter module in the system of forming the directional diagrams of antennas with the number of active elements more than 64.

**Keywords:** integrated circuit, core-chip, C-band, phase shifter, AESA, BiCMOS, SiGe process.

UDC 007.51

## **BLOCK DIAGRAM FOR THE CAR SEAT EMERGENCY SHIFT SYSTEM**

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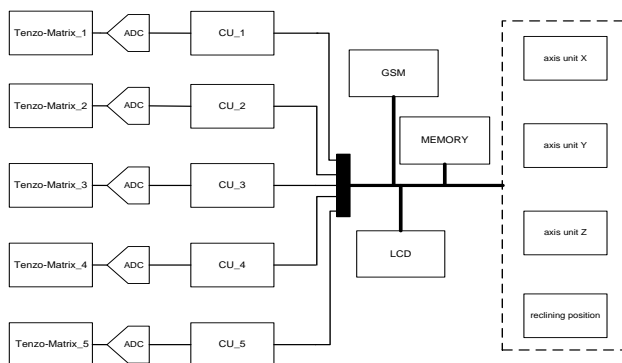
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According to the World Health Organization (WHO), annually more than 15% of car accidents in Russia entail deaths. Quantitatively the value reaches above 50,000 people. This problem cannot be left aside. To reduce the death rate, the car seat emergency shift system is proposed in the paper [1]. The block diagram of the system allows to approach implementation of the system and testing procedure.

The emergency seats shift task is considered as a potential solution to reduce the threat of death in car accidents. It is well known, every second matters in extreme situation such as a car accident. Since the system mechanics time reaction cannot be increased, the only way to improve time reaction is to reduce data transmission latency between units of the system. General block diagram on highest abstraction level is shown in Pic.1



Pic.1 — Common structure scheme on highest abstraction level

The block diagram is designed to reduce system data transmission time delay, however it reaches at the expense of the final product cost increase. This is due to using additional independent control units (BU\_n), instead of one common. The tensor sensor matrix (Matrix TD\_n) generates an analogue signal that is proportional to the vehicle damage level. The ADC digitizes the analogue signal to provide digital format for the BU. The BU processes the data and reads the tensor sensors matrix at each time. It allows to improve system performance. The circuit consists of five units. Each block is assigned to its own car side. There is no need to use a separate transmission lines after the control unit, since data is transmitted toward

output and it does not influence data transmission speed. Integration of the transmission lines into a bus delivers better time reaction of the unit. This block consists of 4 sub-blocks which are responsible for the direction seats shift. The LCD unit is responsible for indication of the vehicle damage level from inside. Areas that have more damage would be highlighted with a color on each three-dimensional axis. MEMORY unit is responsible for storage and ordering data characteristics received from tensor sensors. GSM module is responsible for the data transmission in a picture form, likewise a car, but in verbal format. The data is sent to the owner mobile device.

The proposed system has a potential for enhancement such as a system for automatic car reaction, in damage case. It can fix the body, which damages a vehicle, using controllable cameras and the motion sensor for camera pointing in the direction for the body.

The system has a practical application for one of the most important problems in the world – increasing people`s survival chances in car accidents. In future we plan to develop a system and software operating algorithm for monitoring with the various devices remotely.

In the process of developing a global system, local problem has been solved. Car seat emergency shift system block diagram is developed. The system has an applied value and will be implemented in the future research. It should be taken into consideration that the device does not exclude mortality in the car accident but just reduce its chances.

### **References:**

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**Аннотация.** В статье предложена структурная схема решения задачи аварийного сдвига кресел. Предлагается подход к внедрению системы с минимальной задержкой передачи данных от датчика к механизмам выполнения для перемещения кресел в нужном направлении.

**Ключевые слова:** автомобильные кресла, ДТП, центральный процессов, тензо-датчик, структурная схема.

**Summary.** The system of car seat emergency shift block diagram is proposed in the article. The approach for the system implementation with minimal data transmission latency from the sensor to execution mechanisms to shift the seats in required direction is proposed.

**Key words:** Car Seat, Car Accident, CPU, Tension sensors, block diagram

## MÉTODO PARA REDUCIR EL ERROR DE AMPLITUD EN UN DESFASADOR

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**Introducción. Formulación del problema.** En el desarrollo de desfases por medio de circuitos, similar a llamada celda de Gilbert [1], surge el problema de obtener cantidades de control en un amplio rango de afinación linealmente dependiente de la señal de control (código). Entonces, por ejemplo, para obtener el cambio de fase en un desfaseador vectorial en el rango de 90 grados (para un cuadrante), es necesario que el control del elemento activo sea no lineal. La característica de transmisión de la señal de control se puede representar cualitativamente de acuerdo con la figura 1.

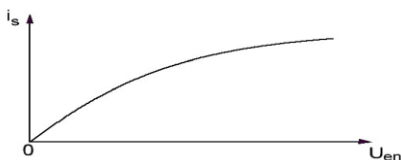


Figura 1 — Explicación de la formación de la señal de control

El motivo de la señal de control no lineal es la no linealidad de la característica de transferencia del elemento directamente activo (transistor).

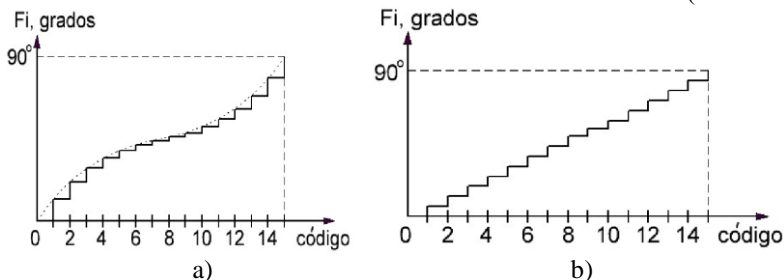


Figura 2 — Comparación de los esquemas de control  
(la fase  $F_i$  de la señal de salida del código de control):  
a — una esquema de control lineal, b — esquema no lineal

Se puede generar una señal de control no lineal seleccionando un circuito de control que incluye elementos cuyas características de transferencia tienen relaciones inversas. Entonces es posible obtener una dependencia lineal de la cantidad controlada mediante el código de control (señal). La figura 2 muestra los gráficos (por el ejemplo del circuito de desfaseador) de las dependencias de fase de la señal de salida del código de control. Figura 2, a — muestra cuando se controla el circuito lineal del generador de señal del conductor, figura 2, b — circuito de control no lineal.

Como se muestra en la figura 3, un circuito de control no lineal permite teóricamente obtener una dependencia lineal de la cantidad controlada en la señal de control (código).

**Característica del circuito del desfaseador.** En funcionamiento, la integral del desfaseador [2] en un modo no lineal, que está controlado por el circuito no lineal, respectivamente. La figura 3 muestra una diagrama de circuito del desfaseador, y la figura 4 — características: fase-frecuencia y la amplitud de frecuencia para un control de combinaciones de código dentro de un cuadrante.

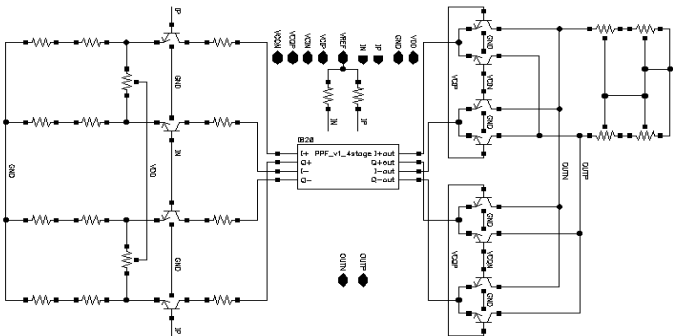


Figura 3 — La esquema del desfaseador (angulado)

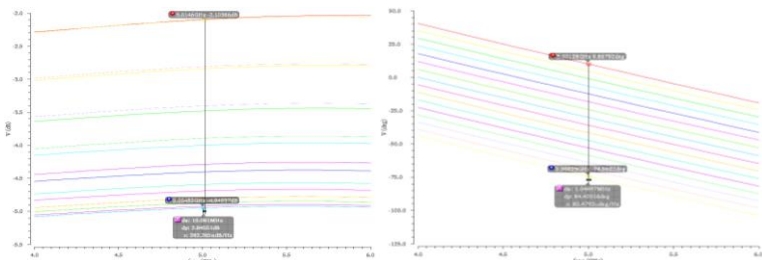
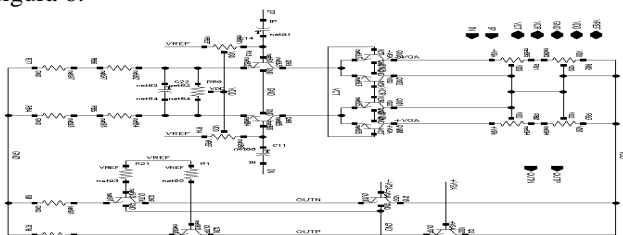


Figura 4 — Las principales dependencias del desfaseador

**Solución de problemas.** Para reducir el factor de transmisión desigual del desfaseador, se decidió hacer la etapa de salida en forma de un atenuador activo. Al mismo tiempo, el atenuador está controlado por las mismas señales de control. La necesidad es solo en la formación de señales de control. El circuito del atenuador se muestra en la figura 6. Como resultado, la estructura del desfaseador se puede representar en la forma que se muestra en la figura 6.



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El resultado de la operación del circuito eléctrico modelado en el sistema Cadence se muestra en la figura 7.

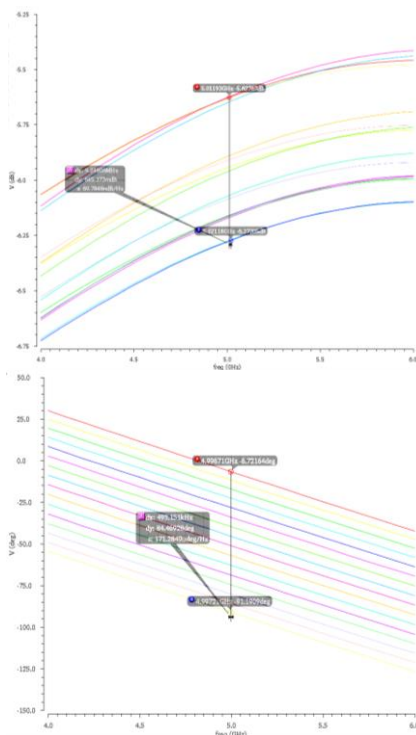


Figura 7 — El resultado de la operación del desfasador

Como se muestra en la figura 7, como resultado del uso del atenuador de salida, el error de amplitud ha disminuido a 0,6 dB.

### Conclusión

Como resultado, se obtiene un circuito cambiador de fase, que incluye: una unidad sumadora de señal para generar la fase de la señal de salida; atenuador activo, corrigiendo el error de amplitud de ajuste del nivel de la señal de salida, y también el circuito de control para estos módulos. Como resultado, fue posible, con un mínimo error de fase (1 grados), reducir el error de amplitud de 3 a 0.6 dB.

En el futuro, se planifica un estudio más detallado del circuito eléctrico recibido del cambiador de fase con la posibilidad de reducir la magnitud del error. En última instancia, se planea desarrollar una topología del cambiador de fase.

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**Аннотация.** В статье представлен метод уменьшения амплитудной ошибки в интегральном векторном фазовращателе. Эта ошибка связана с тем, что при сложении векторов, с помощью которых получают фазу выходного сигнала отличную от 45 градусов, длина результирующего вектора уменьшается. Это приводит к ошибке величиной 3 дБ. Обычно фазовращатели делают с ошибкой не более 1 дБ. Для уменьшения ошибки принято решение использовать встроенную схему корректировки амплитуды на основе активного аттенуатора. Аттенуатор одновременно изменяет длину двух векторов. В связи с этим вносимая фазовая ошибка не увеличивается.

Помимо корректировки неравномерности коэффициента передачи активный аттенуатор имеет ряд других преимуществ. В первую очередь, он позволяет осуществить частотную коррекцию, что невозможно сделать в схеме самого фазовращателя. Также позволяет осуществить температурную коррекцию. В результате, используя в схеме фазовращателя дополнительный аттенуатор возможно получение более стабильных параметров всей схемы.

**Ключевые слова:** фазовращатель, начальная фаза, интегральная схема, С-диапазон, прямо-передающий модуль, БиКМОП.

**Anotación.** El método para disminuir el error de amplitud en el cambiador de fase vectorial integral se presenta en el artículo. Este error se debe al hecho de que cuando se agregan los vectores, por lo que la fase de la señal de salida es diferente de 45 grados, la longitud de los vectores resultantes disminuye. Esto da como resultado un error de 3 dB. Por lo general, los cambiadores de fases producen un error de no más de 1 dB. Para reducir el error, se decidió utilizar el circuito de corrección de amplitud incorporado basado en el atenuador activo. El atenuador cambia simultáneamente la longitud de los dos vectores. A este respecto, el error de fase introducido no aumenta.

Además de ajustar la irregularidad del factor de transmisión, el atenuador activo tiene una serie de otras ventajas. En primer lugar, permite la corrección de frecuencia, lo que no se puede hacer en el mismo cambiador de fase. También permite la corrección de temperatura. Como

resultado, usando un atenuador adicional en el circuito de cambio de fase, es posible obtener parámetros más estables de todo el circuito.

**Encabezamientos de materia:** desfasador, desfase, circuito integrado, BiCMOS, C-rango, core-chip.

UDC 621.396.67

### THREE-FREQUENCY HF ANTENNA WITH REDUCED DIMENSIONS RANGE

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**Main part.** The modified three-frequency HF antenna is shown in Fig. 1 and consists of the following parts: three nested antennas (one of these antennas is represented in Fig. 2), each of which operates at its own frequency (8291 kHz, 12,290 kHz and 16,420 kHz), a hollow cylinder representing reactivity ensuring the matching of the antenna [1].

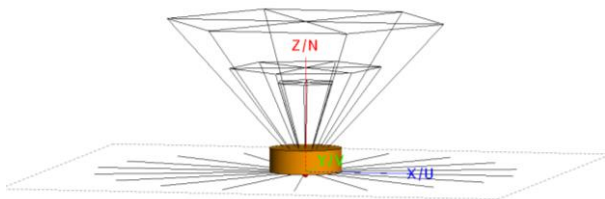


Figure 1 — Model of the modified three-frequency HF antenna

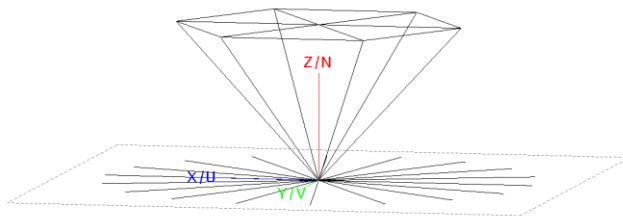


Figure 2 — Modified HF antenna model



The presented HF antenna was modeled in the FEKO CAD system, the simulation results are shown in Fig. 3 and 4.

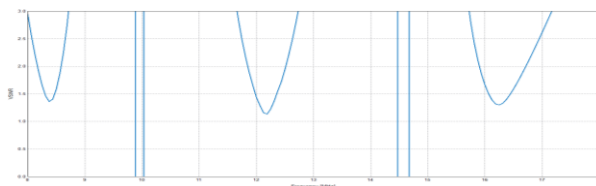


Figure 3 — The SWR of a modified three-frequency HF antenna

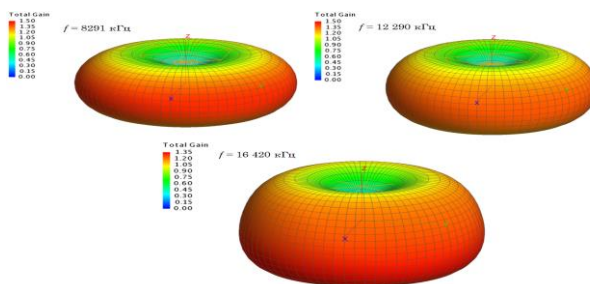


Figure 4 — Directional patterns of the modified three-frequency HF antenna

To reduce the presented antenna, a method was used in which the active parts of the antenna were twisted into a spiral (pic. 5). Thus, the geometric dimensions of the antenna were reduced by thirty percent. However, with this method of reducing the antenna, the matching deteriorates.

It can also be noted that matching three nested antennas into each other provides reactivity, which is presented in the form of a cylinder. A disadvantage of such matching — impossibility of matching each of the three parts of the antenna separately.

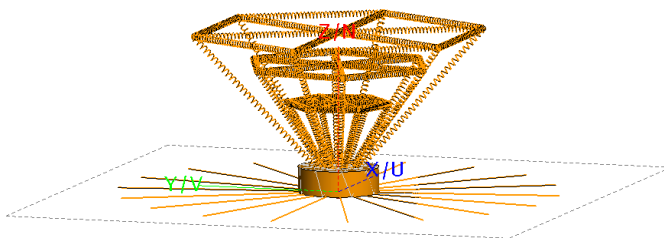


Figure 5 — The model of the reduced modified three-frequency HF antenna

Conclusion. During the research, the antenna was reduced in size. As it was noted earlier, this technique has disadvantages, such as deterioration of antenna matching. The results can be used to develop and implement on ships and coastal radio centers for transmission and reception of short wave bands.

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**Аннотация.** В настоящее время короткие волны используются в основном для дальней связи, поскольку ионосферная волна может распространяться короткими волнами на многие тысячи километров, а для этого не требуются мощные передатчики. Однако все антенны SW имеют довольно большие размеры. Исследованное изобретение представляет собой модифицированную ВЧ антенну, работающую на трех частотах.

Целью изобретения является уменьшение размеров антенны. Это достигается путем скручивания активных элементов в спиральную конструкцию.

**Ключевые слова:** ВЧ-антенна, трехчастотная ВЧ-антенна, ионосферная волна, дальняя связь, мощный передатчик.

**Summary.** At present, short waves are used mainly for long-distance communication, because the ionospheric wave can propagate short waves many thousands of kilometers, and this does not require high-power transmitters. However, all SW antennas have rather large dimensions. The investigated invention is a modified HF antenna operating at three frequencies.

The purpose of the invention is to reduce the size of the antenna – it is achieved by twisting the active elements into a spiral structure.

**Keywords:** HF antenna, three-frequency HF antenna, ionospheric wave, long-distance communication, high-power transmitter.

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## INTEGRATED PHASE SHIFTERS RESEARCH

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**Introduction.** The controlled phase shifter is used to change the phase of the signal depending on the external control signal. Traditionally, to implement managed discrete phase shifters based on compounds of semiconductors classes using passive schemes based on switched LC elements or line segments of the transmission lines. The main disadvantages of such solutions are: large insertion losses, high value of the phase setting error, large area of the crystal topology. These disadvantages are essential for passive phase shifters based on silicon and silicon-germanium technologies due to the inductors low quality, as well as relatively high resistance of open channels of MOSFET transistors used for switching links. Requirements for technological standards regarding the minimum size of protective pockets and sizes of inductors lead to the need to increase the area of the crystal, and accordingly, to an increase in the cost of the product. The use of active vector phase shifters can significantly reduce these disadvantages, and the use of CMOS technologies — to increase the integration degree and reduce products cost.

**Phase shifters application.** It is necessary to generate signals with different phase in many cases. This may be necessary to compensate for the phase advance, as well as the delay of the signals of the form. However, the most effective phase shifters use is in the systems of phased array antennas radiation pattern formation.

The use of phase shifters in AESA is a classic way to form antenna radiation pattern. Figure 1 shows an example of a structural diagram of receiver-transmitter module. Nowadays in Sevastopol state university Engineering center is developing similar core-chips.

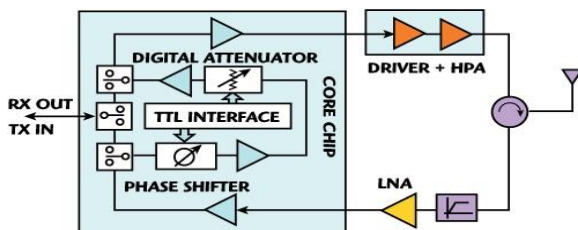


Figure 1 — Developing core-chip example

According to the figure, it can be seen that the phase shifter works both in the receiving mode and in the transmission mode of receiver-

transmitter module. In this way increases the requirement for an operational dynamic range. This is due to the fact that the normally received signal has a very low level, while usually trying to emit a signal with as much power as possible. It is possible to reduce the dynamic range using an attenuator, but it is impossible to fully ensure the operation of the phase shifter with the same signal levels.

### Problem statement

The first problem that arises during phase shifter development is the overlap of the operating frequency range. As a rule, it is not advisable to develop a scheme operating at the same frequency. This is stupid for many reasons, and most importantly, economically unprofitable. It is difficult for most electrical circuits to ensure uniformity of the phase-frequency characteristic over a wide frequency range. In the same turn to provide a wide range of frequencies uniform phase adjustment — the task is not easier.

Taking into account a number of other difficulties encountered during integrated circuits development, pass the study is necessary.

### Research result

As a result of the research it was revealed that among the possible methods of signal phase formation, it would be optimal to use the vector phase shifter scheme for BiCMOS technology and C-band frequency range.

The method of vector addition of orthogonal signals consists in the summation of two signals phase-shifted by  $90^\circ$  (I, Q signals). By varying their amplitudes, it is possible to obtain different values of the initial phase of the total signal with an almost constant amplitude. Advantages of this method are: high phase accuracy, constant amplitude of the total signal and a small crystal area occupied by the circuit.

As an example, an integrated circuit of a six-bit vector phase shifter is described in [1], the structural scheme of which is shown in figure 2.

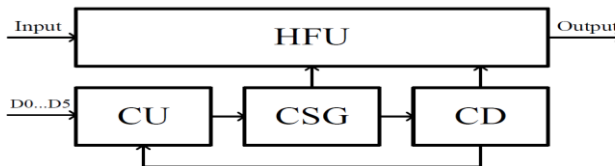


Figure 2 — Vector phase shifter structural diagram

The input signal is fed to the high-frequency unit HFU, where it is converted depending on the values of the output signal of the analog control signal generator CSG. The digital control signals D0—D5 are fed to the inputs of the digital control unit of the control unit CU, which generates

control signals of the CSG unit. The current driver CD generates the reference currents of all circuit blocks.

A number of technological limitations on the use of the element base in the technological process of a lower cost of 0.18  $\mu\text{m}$  SiGe process do not allow simply repeating the considered schemes. The reasons for this are: limitations associated with low breakdown voltages of field-effect transistors, large parasitic capacitance and poor frequency characteristics of field-effect transistors, and others.

Since the vector phase shifter circuit can be implemented in many technological processes, it has been decided to base further development on such a method of forming the phase of the signal.

### **Projected phase shifter structural diagram**

In order to proceed with the development of the phase shifter electric circuit it is necessary to determine its operation. For this, a structural diagram is developed that allows to clearly define the function of each block. As a result, the block diagram includes a polyphase filter (PPF) forming four quadrature signals; a signal adder (ADD), that forming a signal with a desired phase at the output of the PPF; the control circuit of the adder, which is a current digital-to-analog converter (CDAC), an output buffer amplifier (BA), which decouples the output. The enlarged phase shifter block diagram is shown in figure 3.

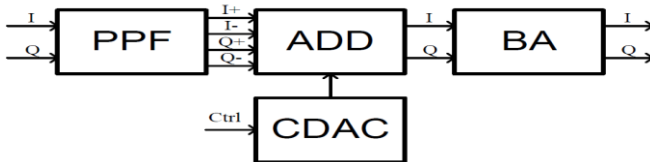


Figure 3 — Projected phase shifter structural diagram

According to the structural diagram shown in figure 3, it is possible to conditionally explain the operation of the phase shifter and determine the main blocks that need to be developed. Two sinusoidal symmetrical signals are fed to the input of a polyphase filter (in the frequency range 4—6 GHz). After that, the polyphaser filter splits these signals into quadrature ones, fed to the input of the adder. By controlling the current digital-analog phase shifter, by feeding a six-digit digital code to its input, an analog control signal is applied to the adder. As a result, a weighted summation of the quadrature signals occurs, which allows one of the pair of vectors to obtain one with the required phase. As a result, two symmetrical signals with a given phase are obtained. To reduce the effect of the load on the operation of the signal adder circuit, a buffer amplifier is provided at the output, which decouples.

**Conclusion.** As a result of the research of existing integrated phase shifters, it was decided that in order to obtain signals in a wide range of phase rearrangement (360 degrees) and a wide frequency range  $df = 4$  GHz, it is optimal to develop a vector phase shifter in BiCMOS technology, which should allow obtaining a small phase error.

It should be noted that when developing the phase shifter, it is necessary to ensure that the phase error is at least not greater than half the low order bit value. So in the case of developing a phase shifter to a 360 degree range with 6-bit control (step 5.625 degrees), the error should not exceed ~2.5 degrees. This is due to the applicability of phase shifters in systems for the formation of antenna patterns. In connection with this, a uniform reorganization of the main antenna maximum can be considered when the RMS phase establishment does not exceed half the required bit capacity.

In the future, taking into account the conducted research, a phase shifter circuit is being developed, as a module of a monolithic integrated circuit crystal of a transmit-receive module for an active electronically scanned antenna. The development is carried out by Sevastopol State University Engineering Center in the framework of the state task.

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**Аннотация.** Статья посвящена исследованию существующих на сегодняшний день интегральных фазовращателей и определению основных проблем при их разработке. Это необходимо для дальнейшей разработки электрической схемы фазовращателя, который является одним из модулей, разрабатываемой Инжиниринговым центром Севастопольского государственного университета монолитной интегральной схемы приемо-передающего модуля активной фазированной антенной решетки. Предполагается использование такого модуля в совокупности с антенной решеткой для обеспечения беспроводной связи нового поколения с высокой скоростью передачи информации.

В работе также представлена структурная схема разрабатываемого фазовращателя, включающая в себя основные функциональные блоки. Однако при дальнейшей разработке схема может корректироваться и расширяться.

**Ключевые слова:** интегральная схема, приемо-передающий модуль ФАР, C-диапазон, фазовращатель, АФАР, БиКМОП, кремний-германиевая технология.

**Summary.** The article is devoted to the investigation of existing integral phase shifters and definition of the main problems in their development. This is necessary for the further development of the electrical circuit of the phase shifter, which is one of the modules developed by the Sevastopol State University Engineering Center of an active phased array antenna receiving and transmitting module monolithic integrated circuit. This module is supposed to be used with the antenna array to provide a new wireless communication generation with a high data rate.

The paper also presents a developed phase shifter structural diagram which includes the main functional blocks. However, with further development, the scheme can be adjusted and expanded.

**Keywords:** integrated circuit, core-chip, C-band, phase shifter, AESA, BiCMOS, SiGe process.

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## **SLEEP QUALITY CONTROL SYSTEM**

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### **Introduction**

Nowadays one of the worldwide research priorities is a problem of ageing. It includes health systems, medical technologies and rare diseases. Important area of research is the development of personalized medical approaches aimed at improving safety and quality of life. Significant role is expected to be played by Information and Communication Technology (ICT) in the frame of Health theme priorities. Next generation of health-care systems will be inextricably linked with new types of mass-market microelectronics devices. New classes of sensors will be applied to prevent or detect disease, to provide rehabilitation and a healthy lifestyle. One of the key areas of needs is related with the implementation of non-invasive sensors for contactless detection of vital signs and ultra-low-power wireless data communication among sensors.

About 30% of the adults in the world suffers from snoring in their sleep. Snoring is not only the reason of obvious social problems, but also it is one of the main symptoms of obstructive sleep apnea syndrome (OSAS). Main danger of OSAS is in breathing stops in a sleep. From 400 to 500 breath stops with duration for up to a minute or more can be observed

overnight in severe forms of syndrome. That time reaches almost four hours of sleep with a lack of oxygen. This significantly increases the risk of developing arterial hypertension, heart rhythm disturbances, myocardial infarction, stroke and sudden infant death syndrome (SIDS). In this frame, particularly relevant is the interest in sensors for contactless respiratory rate monitoring. Moreover, such devices are expected to be the enabling technology for other continuous biomonitring applications, ranging from sleep alert systems for drivers in vehicles to health monitoring of patients in hospital and domestic environment (see figure 1).

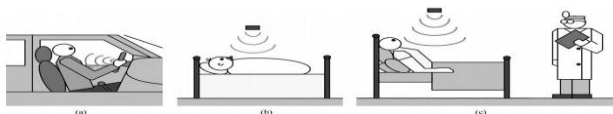


Figure 1 — Examples of possible applications: smart alert for drivers (a), health control for babies in cot beds (b), patients in hospital (c)

This paper reports a design of system for wireless continuous biomonitring. Vital signs monitoring algorithm is based on ultra-wide band (UWB) pulse radar principles. System contains a set of sensors to monitor environmental parameters: air quality, temperature, humidity and illuminance.

### Overview

The «Golden standard» in research of a sleep structure is a polysomnography (PSG). It is multi-parametric test used for diagnostics in sleep medicine. Polysomnography is a comprehensive recording of the biological and physiological processes and changes that occur during sleep. The PSG monitors a set of body parameters and functions, including brain electrical activity (EEG), eye movements (EOG), muscle activity or skeletal muscle activation (EMG), and heart rhythm (ECG). The main disadvantage of this method is that a PSG will typically record more than ten channels requiring a minimum of twenty wire attachments to the patient. Thus, this method is inconvenience for people. It is also unavailable for mass-market because of small number of equipped PSG laboratories.

In recent years, steps to create more simple diagnostic techniques that would have sufficient diagnostic accuracy were taken. Systems that monitor airflow and saturation with the help of the nasal cannula and oximeter were developed (SOMNOcheck micro by Weinmann, Germany). Valuable and sufficiently accurate information makes it possible to obtain with a help of computer pulse oximetry. It is a method for prolonged non-invasive monitoring of hemoglobin saturation with arterial blood oxygen. Computer pulse oximeters are used for monitoring to ensure the recording of a signal with discreteness every few seconds.



However, these devices and methods have a number of disadvantages. These devices for functional diagnostics use contact sensors. They have a high cost and are still largely inaccessible. One of the main directions in the development of such systems is the creation of contactless sensors capable of converting primary medical-biological parameters. Their use will reduce the impact of the system on the research object and increase the reliability of monitoring the functional state and diagnosis. The existing and marketed contactless capacitive, optical sensors in their functional and technical characteristics cannot be used for monitoring the main body systems — respiration and blood circulation.

The solution to this problem is the use of UWB radar systems. Communication committees are reserved internationally 7.5 GHz-wide bandwidth in the radiofrequency range from 3.1 to 10.6 GHz for industrial, scientific and medical approaches and gave the permission for operating and marketing of a new class of devices incorporating ultra-wideband technology.

Pulse radars operate by sending short electromagnetic pulses and receiving the reflected by the target signal. Time of flight of the pulse is proportional to the distance from the target to the radar system. Examples of pulse radar systems implemented by means of discrete components and applied to the detection of vital sign parameters are reported in [4, 6, 7]. UWB radars are very attractive for a large set of civil and military sensing applications (biomedical imaging, surveillance, localization, intra-wall and through-wall detections and ground penetrating) due to perspectives in terms of resolution and extremely low level of Equivalent Isotropically Radiated Power (EIRP) spectral density. Moreover, with relatively to continuous wave radars, UWB radar transceivers present a lower circuit complexity. No frequency conversions are required; it leads to lower power consumption for longer battery autonomy of the system.

Block diagram of the proposed sleep quality control system is shown in figure 2.

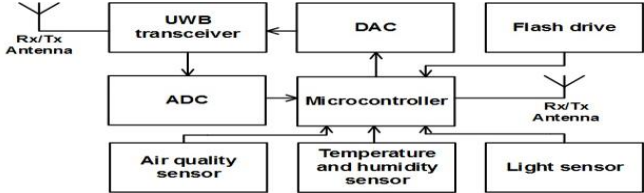


Figure 2 — Block diagram of the sleep quality control system

In figure 2 the following notations are accepted: ADC — analog to digital converter; DAC — digital to analog converter.

The designed system consists of Rx/Tx Antennas, UWB transceiver microwave integrated circuit, ADC and DAC, Microcontroller with Wi-Fi interface (MC) and Flash Drive, set of sensors.

To ensure the possibility of monitoring the variability of cardiac and respiratory rhythms, it is proposed to develop a single-chip UWB transceiver. Its design will solve the problem of microminiaturization of the system, improvement of its functional and cost characteristics. A set of sensors is responsible for monitoring changes in environment parameters where it is intended to monitor a person's functional state (sleep). The air quality sensor should provide an opportunity to determine the concentration of harmful gases in the air in order to prevent negative consequences for the person. Temperature, humidity and illumination sensors are designed to help to determine the causes of sleep disorders when solving problems of sleep study. ADC and DAC are used to convert control and information signals of MC and transceiver. Microcontroller (ESP8266) allows the device to communicate with the user devices through a local computer network or the Internet. Flash Drive is used to store the data from UWB transceiver and sensors.

### Transceiver design

Design of transceiver microwave monolithic integrated circuits (MMIC) is a part of research project which is held in Engineering center of micro- and nanoelectronics devices, Sevastopol State University. Designed block diagram of the UWB transceiver is shown in figure 3.

The pulse generator (PG) function is to transmit short pulses with a frequency  $f_{PR}$  towards the target (human body). Reflected by the human body signals are captured by the receive (Rx) antenna. Than signal is amplified by the LNA and multiplied with delayed replica of transmitted signal (pulses) by multiplier and integrated by integrator (INT). Replica of transmitted pulses generated on-chip by the Delay Line (DL) and Shaper (see figure 3). Output signal of the multiplier is integrated in order to increase the signal-to-noise ratio (SNR) and capture the information on the movement. Vital signs vary within frequency of a few Hertz. So an integrator with a bandwidth of 100 Hz allows an accurate detection. In practice, low-pass filter is used as an integrator.

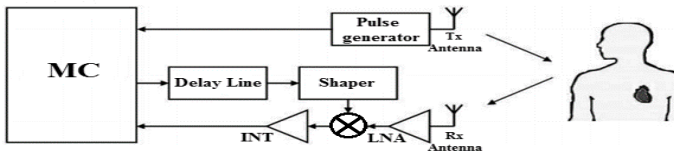


Figure 3 — Block diagram of the UWB transceiver

In figure 3 the following notations are accepted: MC — microcontroller; INT — integrator; LNA — low-noise amplifier.

Averaging numerous pulses (in the order of  $f_{PR}$  and 3-dB bandwidth ratio) allows to increase the output SNR. The delay line (DL) provides a delay equal to the entire time-of-flight (round trip) of the transmitted and received pulses. If the target is not moving (static state), the local replica and the amplified by LNA signal are aligned and the multiplier provides the same output pulse with pulse repetition frequency  $f_{PR}$ . In this case, the signal at the output of the integrator is constant.

The integrator will provide a constant output voltage regardless of the relative time shift between the local replica and amplified reflected signal, for any other constant of the time shift. If the target is moving, the movement causes a time varying this shift between the local replica and the eco amplified by the LNA. Therefore, the multiplier provides an output pulse that may be positive, negative or zero, depending on the time shift caused by the time-varying distance between radar and target and due to the target movements around its quiescent position.

The radar sensor is operated in two modes: ranging mode (RM) and tracking mode (TM). In RM the DL provides a variable time delay in order to find and identify the target. In RM the radar sensor allows us to identify the presence of the target and the time of flight. When the target is detected, the radar can switch to the TM, in which the DL provides a fixed time delay (i.e., equal to the time of flight identified in RM) in order to monitor a fixed range of distances [2]. Therefore, the output voltage is directly sensitive to the target movements, e.g., the chest movement due to the pulmonary activity in case of respiratory rate monitoring.

Schematic diagrams of transceiver functional blocks have been designed according to 180 nm RF CMOS process libraries. They have fully differential topologies for better immunity to electromagnetic interference and noise, and better linearity. The development of schematic diagrams is part of additional research and is described separately.

### **Conclusion**

An overview of the types, methods and design features of bioradiolocation systems have been presented, as well as design results of functional diagram of the sleep control system. Respiratory rate monitoring algorithm in the system is based on UWB pulse radar principles. System contains a set of sensors to monitor environmental parameters such as air quality, temperature, humidity and illuminance.

Ultra-wide band contactless sensing technology could be potentially used in a variety of civil applications, as for constant monitoring of babies in cot beds, hospital patients and other people at risk of obstructive apneas

including, sudden infant death syndrome. It could be applied also for the early detection of sudden sleep of drivers in vehicles. This UWB sensing technology also enables several other important applications such as facilitating patients in being monitored in their home, with data sent in real-time through the network to first-aid medical staff in hospitals. It can also be used for fitness (fatigue) monitoring and personalized healthcare for independent and healthy living. In spite of its applications to the biomedical field, the UWB pulse radar sensor can be also applied to other civil applications requiring contactless detection of moving objects non-transparent to UWB radiation. Future works are addressed to the design of prototype for its validations in large-scale clinical trials and commercialization.

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**Аннотация.** В статье представлены результаты разработки функциональных схем системы контроля и улучшения качества сна, основанной на принципах широкополосной биорадиолокации. В

состав комплекса входят базовое устройство (биорадиолокатор с набором датчиков) и серверное устройство с использованием специализированного программного обеспечения. Система позволяет получать данные о вариабельности сердечного и дыхательного ритмов, температуры, влажности и освещенности помещения и передавать их для обработки в компьютер (мобильное устройство) через интерфейс Wi-Fi стандарта IEEE 802.11 b/g/n. Система контроля качества сна обеспечивает бесконтактное и точное определение частоты дыхания и сердечных сокращений, параметров микроклимата помещения. Радиотехнический комплекс предназначен для использования в специализированных отделениях медицинских клиник, бытовых условиях. С учётом ряда доработок подобные системы могут применяться при поиске людей в случае чрезвычайной ситуации, контроля функционального состояния людей и оборудования в условиях производственного процесса. Следующими этапами проектирования системы являются: разработка топологии интегральной схемы приёмопередатчика; изготовление СВЧ МИС; сборка и отладка устройства с разработкой программной части системы, обеспечивающей реализацию алгоритмов её работы.

**Ключевые слова:** система контроля качества сна, СШП радиолокация, биорадиолокация, система на кристалле, микросхема, *SiGe*, БиКМОП, приёмо-передающий модуль, СВЧ МИС.

**Summary.** Results of functional diagrams design of the sleep quality control and enhancement system based on principles of ultra-wideband bioradiolocation are presented in the article. Complex consists of base unit (bioradar with sensors set) and server device with specialized software. The system provides data of the variability of heart and respiratory rhythms, temperature, humidity and illuminance in order to transmit them for processing in PC (mobile device) via the interface Wi-Fi standard IEEE 802.11 b/g/n. Sleep quality monitoring system provides non-contact and accurate determination of respiratory rate and heart rate, premises microclimate parameters. Radio system was designed for use in specialized departments of hospitals, for domestic use. Taking into account a number of improvements these systems can be used for searching for people in case of emergency, monitoring the functional state of people and equipment in a manufacturing process. The next stages of the system development are: design of layout of the integrated transceiver; production of MMIC; assembly and debugging device with writing a necessary system software to ensure the implementation of its work algorithms.

**Keywords:** sleep control system, UWB radar, bioradiolocation, system on chip, microchip, *SiGe*, BiCMOS, transceiver module, MMIC.

## THE MONITORING SYSTEM OF AIR POLLUTION

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### 1. The monitoring system

The block diagram of the air pollution monitoring system is shown in Fig. 1. The system consists of stationary automatic posts and a server, communication between which is carried out using a mobile network. The connection between the monitoring systems of different states, as well as access to the open part of the information can be carried out through the global Internet [1].

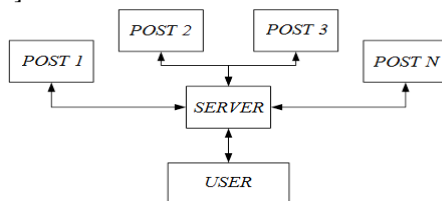


Figure 1 – The block diagram of the air pollution monitoring system

The algorithm of the post has been developed, in accordance with which the nodes of the post, the transformation and processing of information. Work of a post begins with its inclusion by supplying a supply voltage either to all its nodes or to an interface controller that operates in a continuous mode and turns on the power of the remaining nodes of the post programmatically by the server command. Since for each node it takes its time to enter the operational mode, it is advisable to control the inclusion of node nodes by software. After setting the operating mode, N measurements of the concentration of one of the air components are carried out and the

results recorded in the RAM. Then, the received data array is processed: the determination and elimination of a systematic error; averaging to reduce the random error; internal noise compensation; comparison of the measured value of the concentration of the gas component with the maximum permissible. The results of the processing are displayed digitally on the display. If the concentration exceeds the maximum permissible value or the rate of its increase exceeds the permissible value, the server is notified. Further, the post passes to the measurement of the concentration of the next air component using a similar algorithm. After the accumulation of data on the state of the air environment, they are transmitted to the server via the GSM channel. In the off state, monitoring data is stored in the memory of the [1].

Protecting the monitoring system from unauthorized intrusion can be provided with the help of Detection of Suppression technology, which allows to determine a short-term interruption of work and transmit information about penetration to the server. To automatically transfer the communication channels of the monitoring system to the standby server, if the primary server fails, Hot Servers. At the same time, all monitoring data will be preserved, since the servers are connected by a local network.

Each post includes a gas analyzer and radio communication means. The server provides preliminary processing of information about the state of the atmosphere and remote access to posts and the Internet.

## **2. Digital gas analyzer**

The main measuring converter of the automated system is a gas analyzer, which allows to determine the concentration of harmful substances in the atmosphere [2].

The following requirements are imposed on the sensor:

- determination of the concentration of gas-air mixture components in the range from 10 to 1000 ppm with an error of no more than  $\pm 50$  ppm at a temperature of 10 to 40 °C and humidity from 10 to 100 % and conversion of their values into electrical signals;

- time of trouble-free operation of sensors - at least one year;

- low power consumption;

- low cost.

The block diagram of the digital gas analyzer is shown in Fig. 2. The sensor of the harmful gaseous substance  $S_g$  produces an electrical signal proportional to the concentration of this substance in the air (carbon dioxide, carbon monoxide, methane, ammonia, etc.). The analog signals of the sensor are amplified by the amplifier  $A_g$  and through the multiplexer MUX are fed to the digital control unit, which converts them into digital values and processes them according to the program specified.

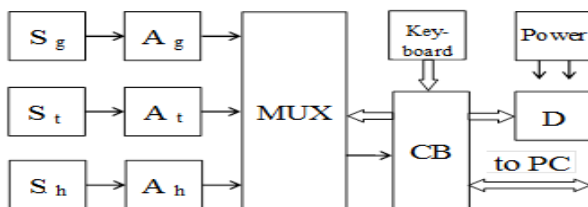


Figure 2 – The block diagram of the digital gas analyzer

Since the sensitivity of the sensor  $S_g$  depends on the temperature and humidity of the air, the sensor structure also includes a temperature sensor  $S_t$  and a humidity sensor  $S_h$ , whose output signals are processed similarly to the signals of a sensor of a harmful substance. This allows you to implement software compensation for these dependencies. To access the control unit, when programming it and exchanging information with external devices, the external interface bus (EIB). The display (D) unit provides visualization of measurement results. The keypad is used to select the operating mode of the gas analyzer, and the power supply unit generates the voltages necessary for its supply [3].

Comparative analysis of industrial sensors of harmful substances has shown that the chemical semiconductor sensor MQ-135 satisfies the given requirements, which allows detecting carbon monoxide, benzene, carbon dioxide, ammonia, nitrogen oxide and alcohol pairs in air at their concentration from 10 up to 1000 ppm. The disadvantage of the sensor is the dependence of its sensitivity on the temperature and humidity of air. To monitor these air parameters, the DHT-22 sensor is selected, which provides humidity measurement in the range of 0 to 100% and temperatures from -40 to +80°C.

The control unit of the gas analyzer can be implemented on a microcontroller such as ATMEGA8 or PIC16F684, which provides sufficient accuracy of measuring the concentration of harmful substance. To display the measurement results, a four-digit digital LCD indicator.

For an autonomous power supply of the gas analyzer, an accumulator or a galvanic cell with a voltage of 6 to 10 V. At the same time, a stable voltage of 5 V supply of sensors and microcircuits can be provided with an inexpensive low-power voltage regulator.

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**Аннотация.** Предложена структурная схема достаточно простой и не дорогой системы мониторинга загрязнения воздуха и разработан алгоритм работы её постов. Показано, что с помощью современных технологий можно обеспечить надежную защиту информации в случае несанкционированного проникновения в систему мониторинга или отказе основного сервера.

Предложена структурная схема цифрового газоанализатора вредных веществ воздушной среды. Произведён выбор датчика газоанализатор, а также микроконтроллера для блока управления и вида цифрового индикатора.

**Ключевые слова:** система мониторинга, загрязнение атмосферного воздуха, пост, алгоритм работы, газоанализатор, газовый датчик.

**Summary:** The structure of an automated monitoring system of atmospheric air pollution is proposed. Main elements of atmosphere analysis system are considered and main requirements for gas sensors are defined. The work algorithm of post of the system of monitoring of atmospheric air contamination is offered. Possibilities of defence of information from an unauthorized access, and maintenance of information in case of refuse of system server are analysed. The structure of the digital gas analyzer of atmospheric air pollution is proposed and its operation is considered. The main requirements for gas analyzer are defined. The types of base elements for gas analyzer realisation are presented.

**Keywords:** monitoring system, atmospheric air pollution, post, work algorithm, gas analyzer, gas sensor

UDC 621.396.67

## **ANALYSIS IMPEDANCE OF THE MICROSTRIP ANTENNA OF REDUCED DIMENSIONS**

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The emergence of new types of portable electronic devices (cellular communication, mobile medicine, security systems, etc.) determine the relevance of the problem of reducing the size of micro-gloss antennas (MPA). At the same time, it is interesting to expand the range of operating frequencies of MPA with reduced dimensions.

To estimate the frequency properties of the antenna at the specified design parameters (for example, the maximum size of the antenna  $l$ ), you can enter the concept of  $Q$ , the minimum limit value of which can be calculated by the formula [1]:

$$Q_{\min} = \frac{1}{M} \left[ \frac{1}{(kl)^2} + \frac{M}{kl} \right], \quad (1)$$

where  $M=1$  corresponds to the excitation field of the linear polarization,  $k = \frac{2\pi}{\lambda}$  — wave number,  $\lambda$  — the wavelength at the operating frequency.

According to the obtained value, it is possible to determine the bandwidth of the operating frequencies In the antenna at a given dimension value  $l$ :

$$B \approx \frac{1}{Q} \left( \frac{VSWR-1}{\sqrt{VSWR}} \right), \quad (2)$$

where  $VSWR$  — asked SWR.

At the same time, it is of practical interest to assess the possibility of changes in the case of reducing the size of the antenna. This problem can be solved on the basis of the analysis of the frequency characteristics of the input impedance  $Z_{in}$ . We present a method for calculating the input impedance of an MPA of reduced dimensions, which does not require a complex mathematical apparatus.

Consider a printed half wave vibrator with a maximum size  $l$  defined by the ratio [2]:

$$l \approx \frac{\lambda}{2\sqrt{\epsilon_0}} \quad (3)$$

where —  $\epsilon$  the dielectric constant of the substrate material MPA with a thickness of  $h$ .

The most effective way to reduce the size of MPA of this type is to "collapse" the radiating surface of the antenna into a "meander" type structure (Fig. 1).

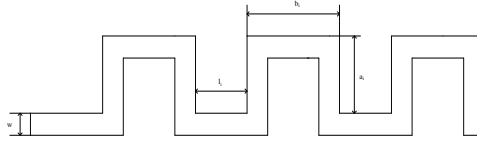


Fig. 1 — MPA, rolled in a structure of type ‘meander’

To determine the input impedance of the antenna under consideration, we present its equivalent circuit in the form of a homogeneous two-wire line, in which, with the geometric periodicity determined by the segments  $l_i$ , the resistances  $Z_{\Sigma i}$  corresponding to the U-shaped fragments of the microstrip structure of the antenna with the sizes  $b_i$  and  $a_i$  are included (fig. 2).

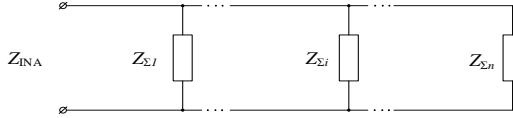


Fig. 2 — The equivalent circuit of MPA with reduced dimensions

The proposed method for calculating the input impedance of a  $Z_{INA}$  is based on the successive recalculations of the input resistance of sections of an equivalent two-wire line from its end to the beginning in terms of the location of U-shaped fragments of the meander  $l_i$  and  $Z_{INA}$  is defined as the input resistance of the latter, counting from the end, ( $Z_{INA} = Z_1$ ).

The calculation is made by the formula (4) [3]:

$$Z_{INi} = W_{line} \cdot \frac{Z_{\Sigma i} + i W_{line} \cdot \operatorname{tg} \beta l_i}{W_{line} + i \cdot Z_{\Sigma i} \cdot \operatorname{tg} \beta l_i}, \quad (4)$$

where  $W_{line}$  — characteristic impedance of the strip line,  $\beta$  — propagation constant of the quasi - T waves.

In turn, resistance  $Z_{\Sigma i}$  determined by the parallel connection of the resistance  $Z_{\Pi i}$  and  $Z_{BXi+1}$ :

$$Z_{\Sigma i} = \frac{Z_{\Pi i} \cdot Z_{INi+1}}{Z_{\Pi i} + Z_{INi+1}}, \quad (5)$$

where  $Z_{\Pi i}$  — input impedance  $\Pi$ - shaped fragment of a meander,  $Z_{INi+1}$  — the input impedance of the phase  $i+1$  is equivalent to the two-wire line.

To calculate the antenna input impedance using the formulas (4) and (5), you must obtain expressions for  $Z_{\Pi i}$ . B the case of performance constructive conditions

$$bi < ai \quad kb \ll 1 \quad (6)$$

you can imagine a U-shaped portion of the square wave as a parallel connection of the two slot radiators:

$$Z_{\Pi i} = \frac{Z_{Si1} \cdot Z_{Si2}}{Z_{S1} + Z_{S2}}$$

where  $Z_{S1}$ ,  $Z_{S2}$  — the radiation resistance of the slots defined by the relations [4]:

$$G = \frac{1}{Z_S} = G^Q + iG^R \quad (7)$$

The values included in the formulas are determined by the relations:

$$G^Q = \frac{\pi \cdot b_i}{\lambda} \cdot \sqrt{\frac{\epsilon_0}{\mu_0}}, \quad G^R = \frac{\pi \cdot b_i}{\lambda} \sqrt{\frac{\epsilon_0}{\mu_0}} (1 - 0,276 \cdot \ln k \cdot h),$$

$$\text{где } e = 8,85 \cdot 10^{-12} \frac{F}{m} \quad \mu = 4 \cdot \pi \cdot 10^{-7} \frac{H}{m}$$

In accordance with the above method, the input impedance of the microstrip wave vibrator was calculated with the following geometric parameters  $l = 48$  mm,  $b = 11$  mm,  $a = 15$  mm at an operating frequency of 800 MHz. For the central frequency  $f_0$  the result is obtained

$$Z = 61,347 + i32,328 \text{ Ом.}$$

When the detuning from the frequency  $f$  by 5%, the calculations give the following values:

$$Z_{INA} = 67,44 + i85,61 \text{ } \Omega \text{ (at a frequency } f_1 = 760 \text{ MHz),}$$

$$Z_{INA} = 70,72 - i112,65 \text{ } \Omega \text{ (at a frequency } f_2 = 840 \text{ MHz).}$$

For the considered variant of the MPA with reduced dimensions have also been modelled in the environment of Antenna Toolbox MATLAB. Frequency characteristics of the  $Z_{INA}$  and the directional diagram for the considered frequencies are shown in Fig.3.

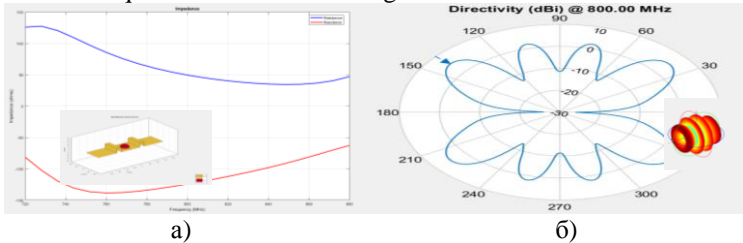


Fig. 3 — Frequency characteristics of the  $Z_{INA}$  (a) and the directivity diagram in XOZ (b) plane of a microstrip half-wave vibrator with a radiant meander-type structure

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**Аннотация.** В работе представлена методика расчета входного импеданса полуволнового микрополоскового вибратора с уменьшенными размерами за счет складывания излучающей поверхности антенны в структуру меандрового типа на плоскости. На основе представления рассматриваемой антенны в виде эквивалентной двухпроводной линии, в которую с определенной геометрической периодичностью входит сопротивление, соответствующее U-образным фрагментам меандра, получены выражения для расчета входного импеданса рассматриваемой антенны. Результаты расчетов сравниваются с данными компьютерного моделирования в Антенном Инструментарии пакета MATLAB. Выявленная разница может быть уменьшена за счет уточнения конструктивных условий, а также использования вычетов с учетом взаимного влияния ближних левых излучателей. Предложенный метод расчета может быть использован при проектировании линейных полосовых конструкций.

**Ключевые слова:** микрополосковая антенна, входное сопротивление, щелевой излучатель.

**Summary.** Thus, the paper presents a method for calculating the input impedance of a microstrip half-wave vibrator with dimensions reduced by folding the radiating surface of the antenna into a meander-type structure on the plane. Based on the representation of the considered antenna in the form of an equivalent two-wire line, in which resistance corresponding to U-shaped fragments of the meander is included with a certain geometric periodicity, expressions for calculating the input impedance of the viewed antenna are obtained. The calculation results are compared with the data of computer simulation in the Antenna Toolbox of MATLAB package. The revealed difference can be reduced due to the specification of design conditions, as well as the use of deductions taking into account the mutual influence of near-left emitters. The proposed method of calculation can be used in the engineering design of linear strip structures.

**Keywords:** microstrip antenna, input impedance, reduced dimensions, operating frequency band, slit emitter.

**WIRELESS PORTABLE SYSTEM FOR BIOMEDICAL RESEARCH***Alexander Petrov, Evgeny Kislyak**4<sup>th</sup> year students, Radio-electronics and telecommunications**Department**Sevastopol State University**e-mail: actinon@list.ru**Alexander Badalov**Scientific adviser, associate professor**Radio-electronics and telecommunications Department**Sevastopol State University**e-mail: a.badalov@mail.ru*

Wireless body area network (WBAN) — is a wireless network of wearable computing devices. BAN devices may be embedded inside the body, implants, may be surface-mounted on the body, depending on type of device or purpose of its use. Modern technologies has enabled a new generation of wireless sensor networks, now used for purposes such as monitoring traffic, crops, infrastructure, health, the level of carbon monoxide etc.

Initial applications of BANs are expected to appear primarily in the healthcare domain, especially for continuous monitoring and logging vital parameters of patients suffering from chronic diseases such as diabetes, asthma and heart attacks.

Advantages of WBAN: communications distance. Disadvantages of WBAN: need for own energy source, increased data transmission loss (available surface losses, channel input etc.)

**Network architecture.** WOSN includes a set of different sensors, a wireless communication device and a microcontroller, through which the data is processed and output to a display (for example user's smartphone). Information, which is sent by WOSN through GSM channel is sent to the database of the medical server. The database supports a unique patient ID. The block diagram of the network is shown in Fig. 1.

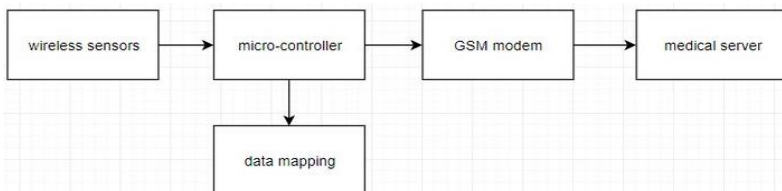


Figure 1. — Block diagram of the data feed of the WOSN.

The signal coding in the GSM channel is not required.

### **Safe operation of the local LAN**

The operating frequency range of the current sensors is in the range from 2.4 GHz to 2.485 GHz. At a frequency of 2.4 GHz, the radiation power is 100 mW. The location of such devices on the human body is basically safe. However, some sensors are responsible for measuring body temperature, so it should be borne in mind that currents arising at ultrahigh frequencies (300 MHz to 3 GHz) cause tissue heating. Waves are absorbed in the surface layers of the human body, causing the occurrence of ion currents, as well as vibrations of water molecules.

There are two main methods for determining physiological indicators: scanning of physical parameters (pressure, bioelectric potential, temperature etc.) and the characteristic of the interaction of physiological parameters with physical fields (the amount of attenuation of electromagnetic waves transmitted through the tissues under study).

In the first case, as a means of protection from the effects of ultra-high frequencies per person, the screening of the sensor is used.

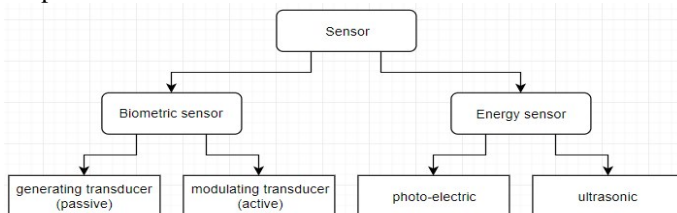
The second uses a timer to turn the sensor on / off, because in this case, continuous monitoring is not required, and the result of the research will not be disturbed.

### **Types of sensors**

Sensors for medical measurements must have the following qualities:

1. High no jammable system.
2. Highest ability to accurately remove and transmit data
3. Possibility of placing on different places of data removal on the human body.
4. Design of sensors

The most important parameter of the classification of medical sensors is their operating principle. The conventional division of the sensors is shown in picture 2.



Pic 2 – The conventional division of the sensors

As an example, consider a *temperature sensor*.

Medical temperature sensors are special sensory devices with a high level of sensitivity, which allows you to measure and track the temperature of the patient.

The body temperature is measured using a high-precision temperature sensor LM35, whose output voltage is proportional to the temperature of the Celsius. This is an electronic device that provides an analog voltage from the surface temperature on which it is installed. The configuration of the LM35 sensor is shown in Pic. 3. The LM35 generates a higher output voltage than the thermocouples and does not require amplification of the output voltage. Usually the body temperature for a normal person is about 36.6 degrees Celsius.

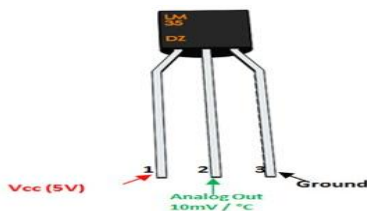


Figure 3. — The sensor for temperature measurement LM35

**Conclusion.** Wireless body area networks allow us to step forward. In further work with these systems, special attention should be paid to transmission losses. As for medicine - very high accuracy of work and small errors of the transferred information is necessary.

In this research paper, we considered the elementary structure of this system. However, the development of this technology will expand the diagnostic capabilities: automatic insertion of insulin into diabetic patients, determination of the threshold value of health indicators and in case of a critical figure - an emergency message to the phone of the attending physician.

The sensor for temperature measurement must be properly designed so that the heating of the sensor itself does not affect the reading of body temperature measurements.

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**Аннотация.** В данной работе рассмотрена беспроводная локальная сенсорная компьютерная сеть (WOSN), в рамках которой



становится возможным беспроводное наблюдение за здоровьем пациента 24 часа в сутки. Предназначенный (WOSN) использует миниатюрные датчики, которые контролируют различные индикаторы здоровья. Эти параметры передаются на сервер врача, который устанавливает пороговые значения показателей здоровья. При превышении установленных значений система отправляет сигнал тревоги на сервер и / или на мобильный телефон врача. Связь между сенсорной системой на человеческом теле и медицинским сервером осуществляется посредством беспроводной технологии GSM.

**Ключевые слова:** беспроводная сеть датчиков площади тела (WBASN); телемедицина; миниатюрные датчики; сервер врача, биомедицинская инженерия

**Summary.** In this research paper, we will consider and organize a wireless on-site sensory computer network (WOSN), within the framework of which it becomes possible to wirelessly monitor the patient's health 24 hours a day. The intended (WOSN) uses miniature sensors that monitor various health indicators. These parameters are transmitted to the doctor's server, which in turn sets the threshold values of health indicators. If the set values are exceeded, the system immediately sends an alarm signal to the server and / or to the doctor's mobile phone. The connection between the sensory system on the human body and the medical server is realized through wireless GSM technology.

**Keywords:** wireless Body Area Sensor Network (WBASN); telemedicine; miniature sensors; physician' server, biomedical engineering

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## **DEVELOPMENT OF A METHOD OF ACCOUNTING FOR THE PROPAGATION CONDITIONS IN SATELLITE NAVIGATION SYSTEMS**

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Currently, the main sources of information on the location of objects are satellite navigation systems (SNS), the basis of which is the exchange of information between the ground (GS) and orbital segments (OS). A distinctive feature of such communication lines is the presence of large radio signal losses due to the energy attenuation on the propagation path, as well as frequency — selective fading [1] in the ionospheric layer of the Earth's atmosphere, which lead to a change in the signal structure and as a consequence to a decrease in the quality of the communication channel.

Currently, the following frequency bands are allocated for satellite radio navigation: narrow bands near 150 and 400 MHz for Doppler RNS; frequency bands 960—1215, 1535—1660, 4200—4400, 5000—5250 and 15400—15700 MHz. They are reserved on a worldwide basis for the use and development of electronic means of air navigation and any directly associated ground-based and space-based equipment.

All links between terrestrial consumers and navigational artificial earth satellites (NAES) are carried out through the Earth's atmosphere, including the troposphere and the ionosphere. From the entire spectrum of electromagnetic waves freely pass through the atmosphere vibrations occupying the range between ionospheric critical frequencies and frequencies absorbed by the rain and atmospheric gases (10 MHz— 20 GHz), as well as the range of visible and infrared rays (1—1000 GHz).

Consider the features of the propagation of radio waves of these ranges, affecting the choice of design parameters SNS. When spreading radionavigation signals (RNS) from NAES to the determining object (DO), the total weakening of the signal energy  $L_{\Sigma}$  from the signal attenuation in

the free space  $L_0$  and additional losses  $L_{\text{add}}$  in the Earth's atmosphere. Attenuation  $L_0$  depends on the wavelength  $\lambda$  and the distance  $r$  between the transmitting and receiving antennas  $L_0 = 16\pi^2 r^2 / \lambda^2$ . Additional losses

are due to absorption of radio waves in the troposphere and the ionosphere,

reflection and scattering of energy on the inhomogeneities of the atmosphere, changes in the shape and polarization plane of radio waves.

In atmospheric propagation, radio waves are absorbed in oxygen, water vapor, rain, and clouds. Resonance absorption in water vapor occurs at a frequency of 22, 23 GHz, and in oxygen — at frequencies of 60 and 120 Hz. The total absorption of radio waves in oxygen and water vapors  $L_a$  dB, when passing through the atmosphere can be calculated by the formula

$$L_a = \gamma_{0o} r_{l0} + \gamma_{\omega o} r_{l\omega} \quad (1)$$

where  $r_{l0}$  и  $r_{l\omega}$  - effective length of the route through the atmosphere, km;  $\gamma_{0o}$  и  $\gamma_{\omega o}$  - oxygen and water vapor absorption.

Absorption of radio waves by rain and suspended particles of water becomes significant at frequencies above 3 GHz [2]. The total absorption of  $L_r$  dB, due to rain on the section of the path length  $r_0$  at frequencies above 2 GHz will be

$$L_r = \int_0^{r_0} \gamma_r(r) dr,$$

where  $\gamma_r$  — the specific absorption of the rain.

It is known [2], in the clouds, the energy of radio waves is experiencing an appreciable absorption only at frequencies above 10 GHz. The scattering of radio waves energy in the considered range in the atmosphere at small angles of the consumer's place  $\gamma$  causes attenuation and distortion of radio signals, and it is usually negligible.

Losses due to the rotation of the polarization plane  $L_p$  in the passage of the ionosphere, assuming that the transmitting and receiving antennas are linearly polarized and oriented in the same way, can be estimated in decibels by the formula  $L_p \approx 20 \lg \cos \gamma$ . The strongest rotation of the polarization plane is observed in the meter range of radio waves at low angles.

Thus, additional weakening of radio waves energy (in decibels) in the Earth's atmosphere can be determined by the formula

$$L_{add} = L_a + L_r + L_p$$

**Calculation of noise at the input of the receiver.** The noise power at the input of the receiver can be determined as [4]

$$P_n = \kappa T_{\Sigma} \Delta F,$$

where  $\kappa = 1,38 \cdot 10^{-23}$  J/K — Boltzmann constant,  $T_{\Sigma}$  — total noise

temperature of the whole receiving system,  $\Delta F$  — the equivalent noise bandwidth of the receiver.

Calculation of the total noise temperature of the entire receiving system is the subject of consideration of radio engineering and is determined by the intensity of both the receiver's own thermal noise  $T_{\text{rec}}$ , and the noise of various sources and circuits external to the receiver input.

**Assessment of refractive errors.** Nonuniform in height distribution of dielectric permittivity causes curvature of the trajectory of propagation of radio waves-refraction. Because of this, the radio propagation time between the transmitter and receiver is different from the rectilinear propagation time at the speed of light. This requires introduction of amendments in determining the range of NAES.

Tropospheric refractive error of measurement quasidelict is determined by the following ratio:

$$\Delta r_{\text{Trec}} \approx \int_{H_{\Pi}}^{H_C} \frac{N(h)dh}{\sqrt{1 - \left( \frac{R_3}{R_3 + h} \right)^2 \cos^2 \gamma}} \quad \text{where: } R_E - \text{the radius of the Earth, } \gamma - \text{elevation,} \quad (2)$$

$$N(h) = [n(h) - 1] 10^6, \quad (3)$$

$N(h)$  - the reduced refractive index of air, where the refractive index of air at a height  $h$  above the Ground.

**The ionospheric error.** To calculate the ionospheric error, we present a complex model of the electron concentration (EC) distribution in the ionosphere in the form (Fig.1) set a uniform layer thickness  $z_e$  with electron concentration  $N$  of located above the thin layer of heterogeneity with the fluctuations of EC, the corresponding  $\Delta N_r(\rho)$ .

The effect on the ionosphere disturbing factors causing the increase as the average integrated EC, and fluctuations  $\Delta N_r(\rho)$ . With, in the first approximation, it can be assumed that the increase in  $\Delta N_r(\rho)$  occurs in proportion to the growth of  $N$ , which is due to the increase in  $N_{\text{em}}$ .

As it is known [3, 5], noise immunity of any optimum receiver is estimated by means of functional dependence  $P_{\text{er}} = \psi(h_0^2)$ , где  $h_0^2$  — input ratio  $E_r/N_0$ , which corresponds to the ratio of signal power and noise at the output of the receiver  $h_0^2 = E_r/N_0 = (P_s/P_n)_{\text{in}}$ .

It is obvious that the influence of absorption in the ionosphere and their refraction lead to an increase in the  $P_{\text{er}}$  due to a decrease in the input ratio  $h^2 = E_r'/N_0$  compared with the provided  $h_0^2 = E_r/N_0$  at an ideal RWP:

$$h^2 = \eta_{n,p} h_0^2, \quad (4)$$

где  $\eta_n < 1$  — energy loss coefficient due to absorption of radio waves in the ionosphere;  $\eta_p < 1$  — the coefficient of energy loss due to inaccurate

pointing of the antennas due to ionospheric refraction.

For these loss factors are characterized by the same type of dependence of the species

$$\eta_{n,p} \sim N/f_0^2. \quad (5)$$

Furthermore, the magnitude  $\eta_{n,p}$  depends essentially on the elevation  $\nu$  of radio routes and equal to zero at  $\nu = 90^\circ$ .

To calculate the statistical characteristics of the field of the received wave at its trans-ionospheric propagation, we apply the analytical method of calculation — the phase-screen method (PSM). The basis of PSM is a model of RWP inside the ionospheric layer, described by the phase screen approximation (PS). This approach better meet the performance model of the distribution of fluctuations of EC in the ionosphere in the form of a thin layer of heterogeneity with the fluctuations of the integral EC  $\Delta N_{T}(\rho)$ .

The PS approach allows to define an expression for the variance of the phase fluctuations of the wave front  $\Delta\phi(\rho, z_3)$  at the output of the ionospheric layer

$$\sigma_\phi^2 \approx 2(\lambda r_e)^2 L_0 z_3 \sigma_{\Delta N_e}^2 = 2(80,8\pi c)^2 L_0 z_3 \left( \frac{\beta N_{em}}{f_0} \right)^2 (rad^2), \quad (6)$$

where  $r_e$  – classical electron radius.

It is known that the PS approximation remains valid for such values

$$\sigma_{\Delta N_e}^2 = (\beta N_{em})^2$$

and  $f_0$  when the value is  $\sigma_\phi^2 \ll 1$ . In this case, the diffraction effects on the inhomogeneities inside the ionospheric layer can be neglected and the amplitude of the output wave can be considered unchanged compared to the incident wave.

$$A(\rho, z_3) \approx A_0.$$

Increase  $\sigma_{\Delta N_e}^2$  or decrease in  $f_0$  leads to the fact that fluctuations in

the phase front of an electromagnetic wave becomes visible inside the inhomogeneous layer. The further propagation of such a wave is accompanied by diffraction effects, as a result of which its front at the output of the ionospheric layer is exposed not only to phase, but also to amplitude fluctuations  $x(\rho, z_3)$ . Dispersion of phase fluctuations  $\sigma_\phi^2$  and amplitudes

$\sigma_x^2$  in the front of the output wave can be determined by solving the problem of propagation and diffraction in a thick inhomogeneous layer in the Rytov approximation (smooth perturbations).

Using the known modification of the spectrum of fluctuations of the refractive index n

$$\Phi_n(k) = \frac{r \left( \gamma + \frac{3}{2} \right) \sigma_n^2 L_0^2}{\pi \sqrt{\pi} r(\gamma) \left( 1 - k^2 L_0^2 \right)^{\gamma + \frac{3}{2}}}, \quad (7)$$

where  $\sigma_n^2 = \left( \frac{\lambda r_e}{k_0} \right)^2 \sigma_{\Delta N_e}^2$  — the variance of the fluctuations of n,

and given that compliance (4)  $\Phi_n(k) \approx \Phi_{\Delta N_e} \approx k^{-4}$  achieved when  $\gamma = 1/2$ , the following result is obtained:

$$\Phi_n(k) = \frac{\sigma_n^2 h_0^2}{\pi^2 (1 + k^2 h_0^2)^2}. \quad (8)$$

Expression defined by (10) for  $\sigma_\phi^2$  has the same view as (8).

Using (8), an expression can be obtained for dispersion of amplitude (level) fluctuations in the wave front at the output of the ionospheric layer in the form of

$$\sigma_x^2 \approx \frac{k_0^2 z_0^2 \sigma_n^2}{L_0} = \frac{2\pi}{c} \cdot \frac{(40, 4z_0 \beta N_{em})^2}{L_0 f_0^3} \quad (9)$$

It is obvious that the statistical characteristics of the field of the received wave will be influenced by fluctuations of both the phase ( $\sigma_\phi^2$ ) and amplitude ( $\sigma_x^2$ ) wave front at the output of the ionospheric layer. At the same time  $\sigma_x^2$ , accounting significantly complicates the method of analytical calculation of statistical characteristics of the received wave and the expression obtained with it. At the same time, the ratio of variances (8) and (9):

$$\frac{\sigma_\phi^2}{\sigma_x^2} = \frac{4\pi L_0^2}{\lambda z_0},$$

shows that for wavelengths used in the SNS, level fluctuations in the amplitude front of the output wave will be significantly less than the phase ( $\sigma_x^2 \ll \sigma_\phi^2$ ) for all values of ionospheric parameters  $\beta$  and  $N_{em}$ , which is a fair approximation of Rytov ( $\sigma_x^2 \leq 0,3$ ).

It follows that for engineering calculations of statistical characteristics

of the field of the received wave in the trans-ionospheric propagation, the results of the simplest PSM can be used as long as the condition of weak fluctuations (12) is fulfilled. Considering, (9) the latter can be presented in the following form

$$(\beta N_{em})^2 \leq 9 \cdot 10^3 \frac{L_0}{z_0^2} \cdot f_0^3 \cdot \quad (10)$$

When changing the ionospheric parameters ( $\beta$ ,  $N_{em}$ ) or the carrier frequency ( $f_0$ ) of the radiated waves (signals) to the values when the boundary condition (10) is violated, the consideration of strong amplitude fluctuations of the output wave ( $\sigma_x^2 > 0,3$ ) in the statistical characteristics of the received wave is mandatory.

However, the solution of this problem by analytical methods (for example, parabolic equation) is difficult [3], and in addition, a general expression for determining  $\sigma_x^2$  the theory of strong fluctuations has not been obtained so far [4].

On the other hand, as the results of experimental studies show, the expression (8) for determination  $\sigma_\phi^2$  remains valid in the field of strong fluctuations. So PSM

can be applied in the case where the value of the parameters  $\beta$ ,  $N_{em}$ ,  $f_0$  does not satisfy the condition (13), however the obtained results should be considered the lower boundary of changes in the statistical characteristics of the field take the waves.

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**Аннотация.** Предложен метод определения суммарного влияния атмосферных факторов на показатели распространения радиоволн существующих и возникающих спутниковых навигационных систем, позволяющий прогнозировать поведение системы в сложных интерференционных условиях, а также судить о достоверности координатной информации определяемых объектов.

**Ключевые слова:** спутниковые навигационные системы, ионосфера, транс-ионосферных каналов передачи данных, полоса когерентности, помехоустойчивость.

**Summary:** The paper proposes a method to determine the total effect of atmospheric factors on radio wave propagation performance of existing and emerging satellite navigation systems, which allows to predict system behavior in complex interference conditions, as well as to judge the reliability of coordinate information determined objects.

**Keywords:** Satellite navigation systems, perturbed ionosphere, trans-ionospheric data transmission channels, coherence band, noise immunity.

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## COMPARING OF VIDEO ANALYTICS SOFTWARE

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Video analytics is a progressive method of video surveillance.

The video analytics is an intellectual analysis of video data flow from the camera (consistently arriving video images) and automatic detecting of the situations programmed in advance. The analytics is used both in real time and during the work with archive. Results of work are tags — logging of situations properties, which can be transferred to the operator of video surveillance system in the form of the message or signed up in archive for the following search in filters or report writing [1].

Today the video analytics can solve rather wide range of tasks of various objects and situations detection and of collecting statistical data. The most relevant tasks (for example, detection and escort of a person in public places) require application of a serious mathematical apparatus. The applied methods on objects detection and classification, as a rule, are quite resource-intensive if we talk about computation. Therefore, various sets of central processing units vector instructions, multithreading and calculations with use of graphic and specialized accelerators (CUDA and OpenCL technology) are widely applied in algorithms of video analytics.

The software can analyze changes of the image in various areas of a shot, carry out record on the movement, noise emergence, according to the schedule, with control of sensors sensitivity.



The modern interface of programs allows to make observation not only in specially equipped workplaces, but also remotely, on mobile monitors, even smartphones. Remote video surveillance is carried out through special cloud-based services, and to rectify it the program server is installed on a computer, and on the device with which it is planned to conduct remote observation, the client program accepting specially created facilitated stream from cameras is installed. Let's present the main scopes of analytics in the table 1.1.

Among a large number of Russian manufacturers' programs, the most popular are:

— Trassir. The software TRASSIR allows to display and record video in the highest quality, to provide remote access to the system even with the slow Internet connection, to provide reliability, flexibility and depth of archival storage;

Table 1.1 — Analytics scopes

Public transport	Safe city	Housing and utilities	Trade and banking networks	Entertainment and sport
Control of compliance with rules, road accidents, number-plate recognition. Passenger counts, detection of people and foreign objects falling on rails.	Detection of crowds, fights or asocial behavior. Detection of abandoned objects, wanted persons.	Detection of the parking violation, control of grounds maintenance, fire and smoke detection. Control of dangerous objects, including fuel and energy complex, control of places with high concentration of people (schools, kindergartens)	Clients counts, analysis of a queue length, trajectory of buyers movement, clients, clients classification, monitoring staff engagement	Calculation of visitors (fans), detection of a fight or scuffle, queue analysis, attention assessment, detection of pair pass.

— GoalCity. The powerful, easily scaled and increased by opportunities hardware and software allowing to solve any problem of objects security. Its main features are: modularity of architecture and distributed network principle of construction. It is the universal security system designed for application on objects of any type.

— Macroscop. This software can work with 95% of cameras models. This is the intellectual program complex for the IP systems of video

surveillance, successfully realizing processing, the analysis, storage and display of video data;

Analytics opportunities:

- work with multistreams;
- existence of the programs' mobile versions;
- existence of its own player for reproduction of records;
- an opportunity to export records to the AVI format to be recognized by Windows players;
- an opportunity to view an archive in any browser with the support of HTML5;
- opportunity of the archive's cloudy storage;
- opportunity to rewrite archives;
- formation and marking of events with filters;
- formation of an analytical algorithms set: identification of the abandoned objects, face recognition, number-plate recognition (an opportunity to read out text data from the moving objects), ...;
- creation of specialized modules: control of motor transport, existence of the module for work with cash registers, ...;
- work with access control and management systems, integration with the security fire-alarm systems;
- access distinction of a large number of users as locally as on network;
- control of the network working capacity and parameter, computers ability to store archives;
- algorithms of coding MJPEG, H.264, H.265;
- existence of archive enciphering;
- opportunity to create the global systems "Safe City", "Smart City".

The choice of an analytical video surveillance program for a specific task is determined by the distinctive features of each software.

Let's consider TRASSIR technologies [2].

— MultiStor II. This technology increases the depth of the archive several times by slightly reducing the archive in the main stream, while obtaining a significant increase of the archive depth in an additional stream. Also it enables to simultaneously write information on multiple hard drives.

— EdgeStorage. The technology improves the reliability of the archive work twice, due to the use of two independent archives in one system.

— MultiStream. The technology allows to view up to 80 megapixel cameras at the same time with a network bandwidth of 6 Mbit/s. At the

same time, the requirements to the processor of the video server or the remote client computer are significantly reduced.

— Heat Maps. The technology makes it possible to impose a color scale on the video frames, which allows to reveal the activity.

TRASSIR has video analysis technology of its own development.

— SIMT — the most powerful motion detector with object tracing function. It has a minimum of settings, automatically adapts to noise and operating conditions. SIMT not only detects motion, but also selects objects based on the parameters that trigger the alarm: object size, relative speed of movement, border crossing, direction of movement, path traversed by the object. This allows to generate alarms on the necessary criteria or to control the PTZ in automatic mode ActiveDome.

— Smoke and fire detectors — innovative video analysis detectors are designed to detect smoke and fire optically in enclosed area and in open area. This technology will enhance the fire protection, as well as ensure the safety of open areas.

— Detectors of sabotage — will warn of sabotage of three types: closing or lighting of the camera, defocusing or damage of the lens, changing the camera's field of view. In case of sabotage, the operator will be warned in a timely manner.

Let's consider GOALCity technologies [3].

Data storage is provided by archive servers. The archive server GOALcity is a manager for recording, storing and viewing video, audio data, as well as the history of system events in the complex or individually for each security element.

To improve the reliability of data storage and transfer, GOALcity developed a new secure file format — SSDF (Secure Streaming Data Format). At the same time, the export speed increased several times. When recording video by events, you can use pre- and post-write buffers. GOALcity implements its own SLFS data storage format, optimized for high-speed multimedia, recording with a high degree of security for each frame, each event.

GOALcity can export archive entries to its protected format or to a self-replicating archive with the integrated interface of the GOALcity player. When exporting data, it is additionally converted using long hash keys on "Enigma" technology (electronic digital signature), ensuring data integrity.

The data is viewed using the integrated in the system player — SpecLab Secure Player 2. The technology of "Watermarks" in Secure Player allows you to protect audio and video data from editing, find the changed frames and areas of non-original records.

Player GOALcity is able to show all cameras simultaneously and synchronously, allowing to see the whole complex of events. In the same time scale events on sensors, keys, various devices are viewed, the values of certain devices are displayed at each moment of time, the sound is played through the selected channels. The GOALcity player service allows you to switch the user's attention from the multichannel view to a single channel at any time by deploying only one camera or another element, perform scaling. The player has a time tape. Unlike other programs that provide information in text form, a visual series of recent events remains on the screen for a time sufficient for the reaction.

GOALCity has its own approach to solving the problem of ensuring the reliability of information. In the case of insufficient bandwidth for recording, for example, several live video streams, or server inaccessibility (computer failure, abnormal situation), data recording will be automatically redirected to another available computer for temporary storage, and the operator of the system will be notified of the violation of work in the network. After restoring the original parameters, the recording files automatically or manually will be sent to the initially specified servers with full synchronization of the database inside the archive and the network as a whole.

Access control GOAL-ACS is conducted with the verification of input parameters for compliance with internal indicators. Considering the possibility of large-scale integration with OPS systems (thousands of sensors), it is very convenient to build a large-scale security system for the GOALplan module to support 3D facility plans, building floors.

This software is able to analyze the nature of audio components and accurately distinguish among other things it is human speech, using the program SL-Voice. As a result, only those sounds which contain conversation of people go to the archive. Pre-recording and post-recording buffers exclude any loss of information during the analysis.

HSC GOALcity is capable of self-tuning to selected tasks. It automatically scans the network, finds compatible servers, monitors the settings.

The third program we will consider is Macroscop [4].

The software translates and writes to the audio archive from IP cameras. The access to the archive located on the SD-card of the camera is provided, including: synchronous viewing of the archive from SD-cards of several cameras; synchronization of archive of the video server with SD-card. The archive is automatically duplicated to a dedicated replication (duplication) server.

Also the ability to view in real time and record videos and audios from cameras (including analog) connected to video decoders, video recorders and video servers was implemented, as well as support of PTZ functions of these cameras.

In Macroscop a special application for Smart TV was developed, which will allow you to view video from IP cameras on a conventional TV. The developers of Macroscop implemented a software solution with which you can build a video wall without using of additional devices or software. In addition, the control interface of the video wall in Macroscop is designed in such a way that it helps to configure work places from any number of monitors, interactively dragging the image from the cameras to the desired monitor.

For video surveillance on a specific object, you should choose the software according to the distinctive features. It is very convenient that many manufacturers offer modular principles of building scalable systems. The tasks of ensuring the security of even very large and complex objects can be solved by modern software and hardware systems based on the reviewed video analytics systems.

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**Аннотация.** Рассмотрены общие принципы построения и характеристики современных систем видеонаблюдения, позволяющих автоматически, без участия человека, формировать журнал заранее заданных типов событий. Выделены алгоритмы видеоаналитики, предназначенные для различных типов объектов. Выявлены преимущества различных программных продуктов российских производителей, предназначенных для построения крупных систем безопасности в рамках программ «Умный город».

**Ключевые слова:** Видеонаблюдение, видеоаналитика, «Умный город», системы безопасности, метка событий.

**Summary.** The general principles of construction and characteristics of modern video surveillance systems are considered, allowing automatically, without the participation of a human, to create a log of predefined types of events. Algorithms of video analytics are designed for different types of objects. The advantages of various software products of Russian manufacturers to build large security systems within the framework of the "Smart City" programs are revealed.

**Keywords:** video surveillance, video analytics, "Smart City", security systems, event label.

UDC 621.396.6

## **THE MICROWAVE SIGNALS OSCILLATOR WITH A SMALL FREQUENCY STEP**

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### **1. Introduction**

The creation of highly stable reference oscillations in the microwave range is an urgent task both in communication technology, and in measuring technology and positioning systems. In this case, often there are conflicting requirements for reference oscillators, namely one-time provision of high stability in frequency and a small step of frequency tuning of the oscillator.

One of the applications of such oscillators is the measurement of amplitude fluctuations and the phase shift of the microwave signal. This problem arises in the study of the physical properties of open traces. This problem is relevant both for studying the statistical properties of radio channels and for measuring physical quantities that affect the amplitude and phase fluctuation of the microwave signal phase. In this case, multifrequency measurements of the amplitude fluctuations and the phase shift of the microwave signal give a more complete volume of information and allow a more detailed study of the propagation of microwave signals.

One way to realize phase measurements in an open microwave channel is the homodyne frequency conversion of the microwave measurement signal. Homodyne measurements are based on the use of the original oscillation as a reference for the conversion of the frequency of the same

signal, but passed through the medium under investigation or reflected from the object of investigation. The initial phase and the frequency of the original oscillations with this measurement method are subtracted from the received signal, respectively, allowing the obtaining of an informative parameter at the output of the mixer of the measuring device [1].

In this paper, the features of creating a high stable reference microwave signal with a small grid spacing for measuring amplitude fluctuations and the phase shift of the microwave signal in the atmospheric communication channel are studied [2].

## 2. The model

When using the method of indirect frequency synthesis, the desire to reduce the frequency grid step by lowering the comparison frequency, leads to an increase in the phase carrier noise level and an increase in the overall synthesizer tuning time. The use of fractional frequency synthesizers does not provide a sufficiently low level of side components in the measuring channel.

To solve this problem, it is proposed to use one high-stable reference oscillator and adjust its microwave oscillators in each measuring channel by its signal. A small frequency shift is formed due to quadrature modulation of the reference signal of the microwave oscillator with indirect frequency synthesis [4].

Control signals for a quadrature oscillator are generated by direct digital synthesis. The block diagram of the synthesizer is shown in the Figure 1.

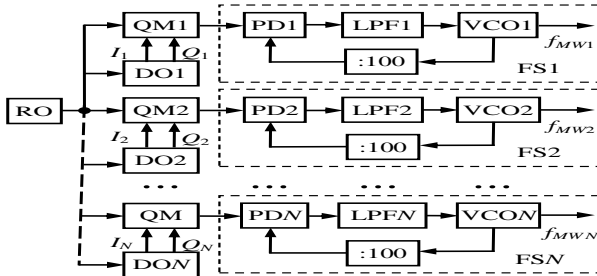


Figure 1. The QAM demodulation functional diagram

In the Figure 1, the following notation is used: RO — reference oscillator; QM — quadrature modulator; DO — digital oscillator; PD — phase detector; LPF — low-pass filter; VCO — voltage controlled microwave oscillator; :100 — frequency divider; FS — frequency synthesizer.

The quadrature modulators are supplied with harmonic signals as modulating signals. At the output of the quadrature modulator we obtain a signal with a frequency shifted by an amount equal to the frequency of the control signals [5]:

$$\cos(\Omega t)\cos(\omega_0 t) - \sin(\omega_0 t)\sin(\Omega t) = \cos[(\omega_0 + \Omega)t] \quad (1)$$

where  $\omega_0$  is the frequency of the signal of the reference oscillator RO,  $\Omega$  is the frequency shift formed by the QM quadrature modulator.

It follows from expression (1) that when the frequencies of the control signals  $I_i$  and  $Q_i$  are changes, the frequency of the reference oscillator is tuned. In this case, the stability of the initial phase of the received signal is determined by the stability of the signal of the reference oscillator, the temperature stability of the parameters of the quadrature modulators, and the stability of the initial phase of the signals  $I_i$  and  $Q_i$ .

### 3. Practical results

Let's consider in more detail the implementation of a microwave synthesizer with a small grid spacing.

A reference oscillator with low phase noise CVHD950-100 from Crystek Crystals is selected to create a frequency shift device, with the following characteristics: operating frequency 100 MHz, relative frequency instability 20 ppm, phase noise level  $-135$  dB / Hz, with a detuning of 1 kHz, the input voltage is  $3.3 \pm 0.3$  V.

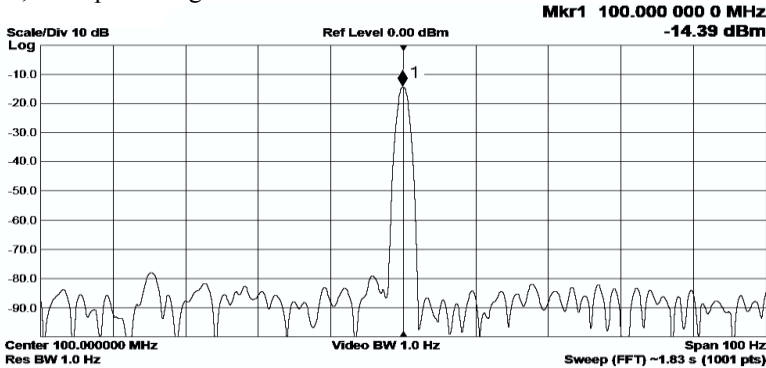


Figure 2. The spectrum of the reference oscillator signal.

As a modulator, the silicon-germanium broadband quadrature modulator MC696LP4E from Hittite Microwave Corporation was chosen. It has the following parameters: frequency range 20 ... 2700 MHz, noise level  $-162$  dBm / Hz, linearity of OIP3 23.7 dBm.



The control signals are applied to the quadrature modulator using two direct synthesizer synthesizers AD9833, which have a resolution of 0.1 Hz and a 10-bit analog to digital converter with a 28-bit phase accumulator. Synthesizers are clocked by a signal from one reference oscillator and run synchronously.

Thus, from one highly stable reference oscillator with a frequency of 100 MHz it is suggested to form a frequency grid

$$f_{ref\ i} = 100 \text{ MHz} + \Delta f_i, \quad (2)$$

where  $\Delta f_i$  — the frequency shift of the reference signal from 1 kHz to 10 kHz.

In the course of research, a functional scheme of the quadrature demodulator was developed. A mathematical model for simulating the operation of the system has been created. The elements were calculated and matched and the system operation was simulated with the parameters specified earlier. The results of the simulation, as well as the parameters of the elements, are presented above.

Let us consider in more detail the characteristics of the reference signal of the frequency synthesizers in the frequency range in Figure 1 for the frequency of 100.01 MHz. The spectrum of the reference signal of the synthesizers is shown in Figure 2. This spectrum corresponds to quadrature modulating signals with a frequency of 10 kHz.

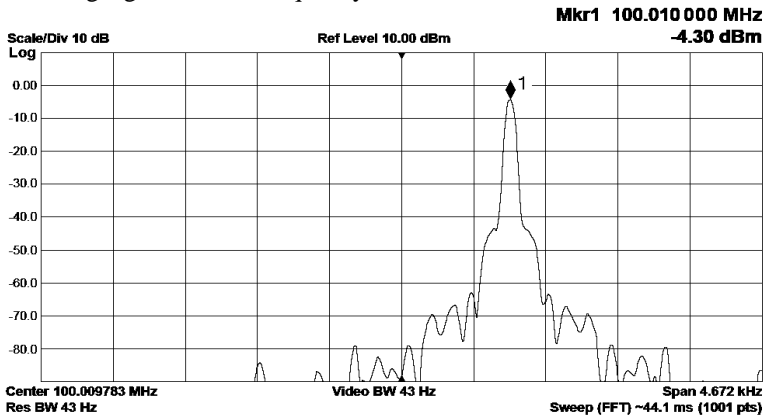


Figure 3. The spectrum of the reference signal frequency synthesizer.

It follows from Figure 2, the reference signal of the frequency synthesizer has a side-component level in the spectrum of less than -40 dB in the 500 Hz band.

#### 4. Conclusion

Thus, the proposed microwave signal oscillator with a small grid spacing allows us to investigate the properties of the microwave channel in the range of 10 GHz. Due to the formation of a discrete grid of frequencies with a step of 100 kHz on the basis of a single reference oscillator, the accuracy and informativeness of the homodyne measuring system can be greatly improved.

The choice of the frequency of a highly stable reference oscillator of 100 MHz allows the transmission of a reference signal with a frequency 100 times lower than the frequency of the microwave oscillator. Thus, the transmission path of the reference signal is simplified and the requirements to its parameters are reduced, the losses in the path are reduced. At the same time, a decrease in the frequency division in the frequency synthesizer with indirect synthesis of the FS leads to a decrease in the phase noise level of the generated microwave signal.

The proposed microwave signal oscillator can be used to measure the characteristics of microwave equipment and in the development of multichannel telecommunication systems [5].

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**Аннотация.** Рассмотрен процесс формирования микроволновых сигналов в диапазоне 10 ГГц с малым шагом сетки частот. Показано, что для получения приемлемых качественных характеристик микроволнового сигнала, полученного методом косвенного синтеза, частота сравнения, на которой работает фазовый детектор, должна быть как можно ближе к частоте синтезируемого сигнала. При этом малый частотный сдвиг формируется за счёт квадратурной модуляции опорного сигнала микроволнового генератора с косвенным синтезом частот.

Таким образом, разработана система, позволяет сформировать дискретный ряд сигналов с малым шагом сетки частот на базе одного опорного генератора для микроволновых измерительных и телекоммуникационных систем.

**Ключевые слова:** синтез частот, синхронизация, фазовые измерения, фазовый шум, набег фазы, квадратурная модуляция.

**Summary.** The process of forming a microwave signal of 10 GHz band with a small frequency step is considered. It is shown that to obtain acceptable quality characteristics of the microwave signal received by indirect synthesis, comparing the frequency at which operates the phase detector should be as close as possible to the frequency synthesized signal. This small frequency shift is generated due to the quadrature modulation of the reference microwave signal oscillator with indirect frequency synthesis.

Thus, the developed system allows to generate a discrete set of signals with small channel spacing based on a single reference oscillator for microwave measurement and telecommunication systems.

**Keywords:** frequency synthesis, synchronization, phase measurement, phase noise, phase progression, quadrature modulation.

UDC 004.31

## **VERILOG IMPLEMENTATION OF DIGITAL CONTROL UNIT**

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## Introduction

Methods of digital control unit (DCU) constructing are practically independent of the chosen methods phase shifters (PSS) and attenuators (ATT) constructing.

For the implementation of DCU the configuration of control bits and time diagrams are significant. Only these parameters will be considered below.

## Brief overview of DCUs

Integrated circuit (IC) CGY2175BUH / C1 [1] consists of a 6-bit phase shifter, a 6-bit attenuator and a transmit/receive switch. The serial to parallel converter minimizes the number of pads and greatly facilitates the use of all IC functions.

Work features (fig. 1):

- Data (Din) is set on the rising edge of the clock signal (CLK).
- The latch (LE) must occur after all 12 bits have loaded, but before the next positive clock edge arrives.
- The output data (Dout) is available when a positive clock edge occurs after the latch enable signal.
- Din is a sequence consisting of 12 information bits in the range from b0 to b11. The parallel bits D0...D11 are internal.

IC CHC3014-99F [2] consists of a 6-bit phase shifter, a 6-bit attenuator, a 2-bit correction attenuator, buffers with automatic bias, a switch and TTL-compatible parallel interfaces.

IC XZ1002-BD [3] consists of transmit / receive switches, low-noise amplifier (LNA), 6-bit phase shifter, 5-bit attenuator and amplification driver. The digital control unit allows to work with the parallel input code, that is why the state of the phase shifter and attenuator can be changed immediately.

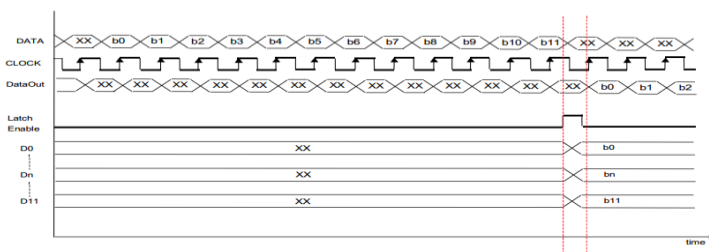


Figure 1 - Timing diagram of the operation of the BCU

## Structure of developed DCU

The following structure of the digital control unit was proposed based on the analysis of other developments.

DCU (fig. 1) consists of main control module (LC), temperature correction module (TSC), two bus multiplexers (P\_MUX and A\_MUX).

The LC module generates external control signals (*att* and *pss*) for the primary attenuator (A), the primary phase shifter (P) and internal control signals for the correction phase shifter (Pc) and the correction attenuator (Ac). Internal signals are transmitted to the bus multiplexers. The TSC receives *pss* and *att* control signals and signal from the temperature sensor (TS). TSC module generates control signals for Pc and Ac, which transmitted to the corresponding bus multiplexers. User can choose external correction signal (*ps\_cu*, *att\_cu* or automatically generated by the TSC module (*pss\_ct*, *att\_ct*) for Pc and Ac using C1 and C2 selection signals.

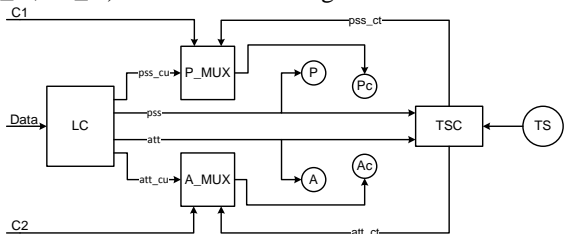


Figure 2 — Block diagram of the digital control unit

### Configuration and operating of DCU

RTL-view of the digital control unit (fig.3 and fig.4) is formed using Xilinx ISE.

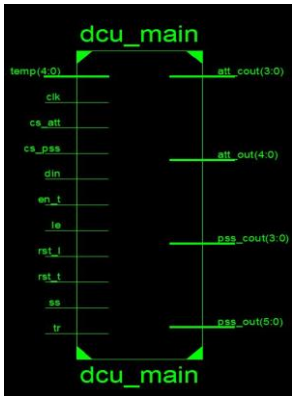


Figure 3 — Digital control unit

38-bit control code (*data\_in*) is transmitted to the input module logic\_control. It is possible to work with data transmit mode and with data receive mode. Most significant 19 bits of 38-bit code are for receive data

mode, and the least significant 19 bits are for transmit data mode. The 19-bit code is a concatenation of control signals arranged in the following order: *pss* [18:13], *att* [12:8], *att\_c* [7:4], *pss\_c* [3:0]. Also, the following signals are sent to the input of the unit:

- *clk* (clock signal),
- *le* (transmit enable signal),
- *ss* (control unit selection signal),
- *rst\_l* (reset signal),
- *tr* (operating mode selection signal: receive or transmit).

DCU generates control signals for the primary phase shifter (*pss* — 6 bit), for the main attenuator (*att* — 5 bit), for the correction phase shifter (*pss\_c* — 4 bit) and for the correction attenuator (*att\_c* — 4 bit).

*Pss* and *att* signals are immediately transmitted to the inputs of the respective digital-to-analog units.

*Pss\_c* and *att\_c* signals are transmitted to the inputs of *pss\_mux* and *att\_mux* bus multiplexers.

The temperature correction module (*temp\_comp*) receives data from the temperature sensor and from the *att* and *pss* buses of the logic\_control module. Module generates control signals for the correction phase shifter (*pss\_ct* — 4 bit) and the correction attenuator (*att\_ct* — 4 bit). These signals are transmitted to the multiplexers *pss\_mux* and *att\_mux*.

Also, temperature correction module receives clock (*clk*), reset (*rst\_t*) and work enable (*en\_t*) signals.

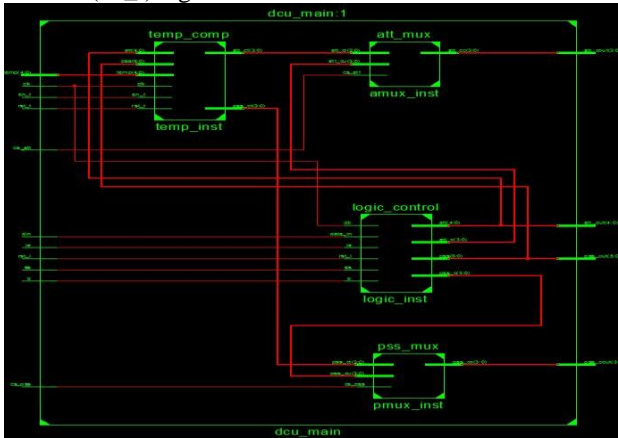


Figure 4 — Internal modules of the digital control unit

Bus multiplexer *pss\_mux* has two data inputs (*pss\_cu*, *pss\_ct*) and control input (*cs\_pss*).

Bus multiplexer *att\_mux* also has two data inputs (*att\_cu*, *att\_ct*) and a control input (*cs\_att*).

Control signals for the correction phase shifter and the correction attenuator are formed at the output of these modules.

### Results

The operation of the digital control unit in more detail on a specific example is considered (fig. 5).



Figure 5 — The result of the DCU simulation

To save the incoming data, the SS signal is changed from the "high" state to the "low" state. After receiving the data, the SS signal should be "high" again. Data is saved. To transfer data to the output *le* signal must be "high". By setting "1" and "0" to the *tr* input we change the mode of operation of the unit. At *tr* = 0 observed transmission of 19 most significant bits of the control code (fig. 6), which corresponds to the mode of "data receive".

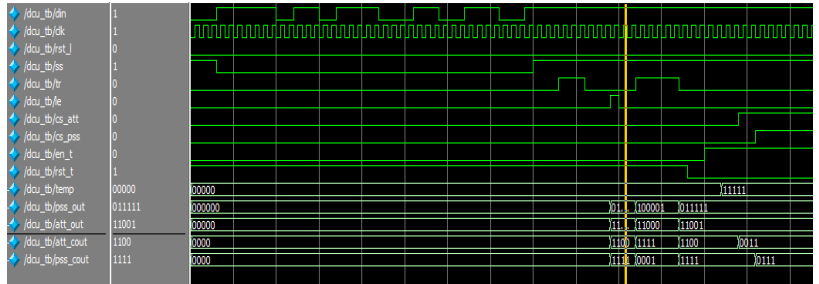


Рисунок 6 — Receive data mode

When *tr* = 1 the transmit of the 19 least significant bits of control code (Fig. 7), which corresponds to the mode of "data transmit".

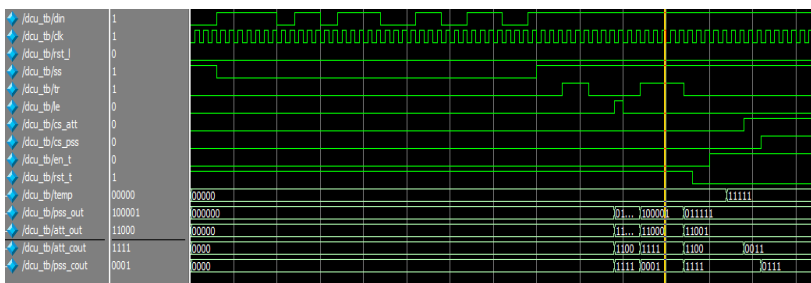


Рисунок 7 — Transmit data mode

At  $tr = 0$  the mode "data receive" observed again.

It should be noted that up to this point,  $rst\_t$  and  $en\_t$  signals were equal to zero. And the control signals of the multiplexers were equal to zeros too. This means that user control signals were sent to the inputs of the correction attenuator and correction phase shifter, and the temperature correction unit did not perform automatic correction.

If  $rst\_t$  and  $en\_t$  signals are setted respectively to 0 and 1, the "reading" of temperature data and control signals  $att$ ,  $pss$  starts. Autocorrection control signals transmit to multiplexers. If  $cs\_att$  and  $cs\_pss$  signals are setted to 1, Autocorrection control signals transmitted to the correction phase shifter and correction attenuator. The generated signals fully correspond to the required.

The developed digital control unit works correctly in the transmit/receive modes. It can be used in active electronically scanned array.

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**Аннотация.** В статье приведено описание разработки блока цифрового управления, который может использоваться для управления амплитудно-фазовым распределением и режимами работы



приемопередающих модулей активной фазированной антенной решетки. Для создания модуля использовался язык описания аппаратуры Verilog HDL.

**Ключевые слова:** Verilog, цифровой блок управления, термодокоррекция, фазовращатель, аттенуатор.

**Summary.** The development of the digital control unit, which can be used to control the amplitude-phase distribution and operation modes of the transmit-receive modules of the active electronically scanned array is described in the article. The hardware description language Verilog HDL is used to create the unit.

**Keywords:** Verilog, digital control unit, temperature correction, phase shifter, attenuator.

UDC 62 - 51

## NEW METHODS OF CONTROL OF HOUSE AUTOMATION SYSTEMS

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Since 50th years of the last century the systems of house automation "Digital home" have progressed. These are the high-tech systems intended for ensuring the maximum convenience and safety of inhabitants of buildings (inhabited or public). Such systems are able to analyze conditions and to change them aside, increasing feelings of comfort. It is desirable that these changes have been happened before the person realizes need of changes. However, if the inhabitant has formulated the wishes already, then the transference of them to system has to happen to the minimum efforts.

Modern systems provide to users a wide choice of the operated devices united by the general tasks and allows to control life support systems: heating, ventilation and/or conditioning; lighting, sun blind and blinds; volumes of consumption of energy, water, other resources; and also multimedia equipment and security systems: the alarm system – security and fire; control system of access and video surveillance.

The system can be constructed by the centralized or decentralized principle. In the centralized "digital home" the control of all devices and engineering systems is carried out by the central controller. The main advantage — a possibility of creation of difficult scenarios on the basis of use of a huge number of the equipment in various combinations for achievement of the maximum level of convenience. The centralized systems can be as wire (Ctestron, AMX, Evika), and wireless (Z-wave).

In wire systems all actuation devices (sensors, switches, control units climate, various managing directors of the panel) communicate the uniform wire information tire on which there are signals to actuation mechanisms. As the wire tire special cables are used, twisted couple is more rare, even power lines can be used.

The main advantages of this type of systems are:

- high speed of a response;
- unique design of each control element;
- reliability and practicality;
- a wide choice of subsystems with ability to integrate;
- long service life;
- safety.

In wireless systems the signal from actuation devices goes to executive on a radio channel. Each wireless switch is also the transceiver.

Are among the main advantages of these types of systems:

- low cost;
- smaller time for installation of system;
- esthetics - lack of wires and additional devices;
- a possibility of system development without project.

In case of the decentralized "digital home" each actuation mechanism bears in itself the microprocessor with non-volatile memory. At failure of one of devices, all system continues to work regularly, except the devices connected to this device. It provides reliability and flexibility of such systems.

Modern systems use various combinations of specially developed actuation devices like control panels and are installed in those devices which accompany users continually — in tablets and smartphones. Such opportunity has appeared about ten years ago and is used as for local, and remote management.

Voice-activated control by household devices, smartphones — the option of management, most natural to the person. Despite essential development in recent years while such way didn't become primary, however has the prospects of wide circulation - voice-activated control can subordinate almost each electronic device and to provide implementation of

difficult multicomponent scenarios. As a rule, voice-activated control is used in parallel with usual — manual that increases non-failure operation of work of system.

Voice-activated control for the systems "digital home" is the function of system allowing to operate scenarios by means of a set of the teams consisting of certain words or phrases. These "words" make library — the fixed list. Initially the system with the standard teams corresponding to the programmed functions of the equipment which are performed on a voice command is offered to the user. If desired this list can be specified and supplemented.

The system has to allocate automatically team against the background of noise and other words and distinguish her — to correlate to a concrete word from the list.

The most important stage of recognition, allocation of the informative and spectral and time signs which are unambiguously characterizing a speech signal is. Spectral and time signs of the speech message allow to reflect an originality of a form of a temporary row and a range of voice impulses at different persons and feature of the filtering functions of their speech paths. Also they characterize the features of a speech stream connected with dynamics of reorganization of articulation organs of speech speaking, and are integrated characteristics of a speech stream.

The systems of recognition of the speech most effectively develop in three directions:

- the analysis of the speech for the purpose of identification of similarity with the required words of the limited dictionary (management in various automated systems, the translation of the speech in the text);
- for the purpose of identification of similarity with the speech of a concrete individual (identification in the military purposes, access control);
- for the purpose of identification of an emotion, characteristic conditions of the person the purposes (safety, telecommunications).

There are various mathematical methods suitable for the analysis of a speech range. Fourier's transformation is the most widely used, but works and on search of other ways of parametrization of the speech are conducted. One of such new directions, is veyvlt - analysis.

Now the market of systems of recognition of the speech is presented by a set of applications. Developments in this direction are engaged the largest companies, such as Google, Apple, Microsoft, etc.

The most known software products on recognition of the speech are:

- VoiceNavigator;
- Dragon Dictation (Nuance Communications);
- SIRI;

- Google Web Speech.

VoiceNavigator is development of the Center of Speech Technologies (CST) — the Russian company with more than 20 years history. The technology of recognition and synthesis of the speech from CST was initially developed for Russian, unlike approach of the Nuance and Google companies for which the native language of development is English, and emergence technologists of recognition for the Russian speech became result of adaptation of technology of one language to another.

Dragon Dictation works at the iOS platform and allows to distinguish phrases up to 30 seconds long by means of a cloud computing. According to the company of the developer the quality of recognition is 90% that is the main advantage of this product.

The Siri (Speech Interpretation and Recognition Interface) system — the personal assistant and help system developed for iOS. This application uses processing of the natural speech for search of answers to the formulated questions. Siri adapts to each user individually, studying his preferences for a long time that it undoubtedly allocates it against the background of other programs.

Development of Google Web Speech is applied in mobile devices and also is built in the Google Chrome browser and voice search. At this product there is a possibility of input of voice messages at the turned-off Internet access. The system distinguishes the whole phrases that considerably simplifies input of the text and also a possibility of management of events. What is especially important, among thirty languages which are supported by Web Speech API, there is also Russian.

There are several indicators on which it is necessary to estimate quality of a voice recognition system (recognition speed, reliability of the system, the cost, privacy, etc.), the most significant is Word Correctly Recognized or WCR (percentage coefficient of correctly recognizable words). By result of recognition the quantity of mistakes for determination of coefficient of WCR was fixed.

$$WCR = \frac{N}{M} \cdot 100\% , where$$

$N$  — quantity of correctly recognizable words;

$M$  — total of the recognizable words.

Recognition of the text the Dragon Dictation program was carried on the mobile device with Android system [2]. When testing technology of recognition of VoiceNavigator was used the demo stand on the website of the developer . And at a SIRI technology research from Apple support of Russian therefore determination of quality of recognition was conducted in English wasn't used.

Table 1 — Comparison of indicators of quality of recognition of the speech

System of recognition of the speech	Dragon Dictation	Google Web Speech	VoiceNavigator	Apple SIRI
WCR coefficient	85	75	70	65

All above-mentioned software products on recognition of the speech have rather successfully proved in the market of modern technologies, however from table 1 it is visible that most qualitatively recognizes the speech the Dragon dictation system from the Nuance company.

As a result of testing of all four systems it is possible to draw a conclusion that the most frequent mistakes were cases of pronunciation of a word, similar on sounding, wrong definition of cases and also emergence in the text of initially absent unions. Also it is necessary to pay attention to decline in quality of recognition at acceleration of tempo of speech.

Thus, in actual practice, without the special training speaking and creation of ideal skilled conditions, characteristics of recognition of the speech have lower values, unlike declared producers that speaks about need of improvement of technologies in the field of recognition of the speech.

The main tendencies of development of voice-activated control are connected with high demand of "digital home" technology and fast development of available applications for mobile devices today. The equipment, especially important for management, is the possibility of off-line of recognition (in the conditions of lack of the steady and fast channel of the Internet).

One of widespread and simple in realization of "first step" to creation of system of "digital home" is the Arduino platform. She gives opportunities of creation of any operated devices including by means of voice-activated control. This platform allows the computer to be beyond the virtual world in physical and to interact with him. Devices on the basis of Arduino can obtain information on the environment by means of various sensors and operate various actuation mechanisms. For voice-activated control include the special application, which allows on and off loadings, to change the operating modes, for example, by voice to regulate lighting brightness. Such tasks of a shoulder even to school students — young researchers from a circle of radio electronics of Radio Electronics and Telecommunications department of the Sevastopol state university. Work in this direction is continued, new projects are developed.

The voice method of control over devices and devices is innovative, it will be undoubtedly to develop actively in the nearest future, and in very fast future each house will become "digital".

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**Аннотация.** Статья посвящена новым методам управления системами домашней автоматизации. В статье рассмотрены перспективы развития системы «Умный дом». Представлены основные тенденции развития голосового управления. С помощью коэффициента WCR оценено качество систем распознавания голоса *VoiceNavigator*, *Dragon Dictation*, *SIRI*, *Google Web Speech*. Проанализированы основные этапы распознавания речевых сигналов. Предложены новые проекты для юных радиоэлектроников.

**Ключевые слова:** голосовое управление, распознавание речи, умный дом, радиоэлектроника, коэффициент распознавания речи.

**Summary.** The article is devoted to new methods of control of home automation systems. The prospects of development of the "Smart home" system are considered. The main trends of the development of voice control are presented. The quality of Dragon Dictation, SIRI, Google Web Speech voice recognition systems was estimated using the CSC coefficient. The main stages of speech signal recognition are analyzed. New projects for young radio electronics school students are offered.

**Keywords:** key words: voice control, speech recognition, radio electronics, smart house, Word Correctly Recognized rate

## **THE QUADRATURE DEMODULATOR BASED ON THE PROGRAMMABLE LOGIC INTEGRATED CIRCUIT**

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Currently, not one person does not dispense with devices and telecommunications systems. These systems evolve at an unimaginable speed, requiring ever more complex technical solutions. On the other hand, the number of users is increasing, which leads to an increase in the volume of transmitted information, hence, it requires an increase in the speed of the systems for receiving and transmitting information.

The solution to this problem is possible due to the use of various types of modulation, coding methods and signal processing. Therefore, there is a need to introduce a number of stringent requirements for modern systems: high performance, compactness, providing a high signal-to-noise ratio, maximizing the use of a dedicated frequency band, providing synchronization, ease of use,

To satisfy these conditions, multiposition quadrature amplitude modulation (QAM) is widely used, capable of transmitting several bits of information in one symbol. Nowadays this type of modulation is widely used in data transmission systems over a two-wire line with frequency separation of received and transmitting information, digital television systems and digital modems.

This thesis project is dedicated to the development of quadrature demodulator based on programmable logic integrated circuits, which designed for processing the simulated signal, with subsequent transformation of it into 8-bit binary code.

QAM modulator and QAM demodulator are key elements within any quadrature amplitude modulation system. The modulator and demodulator are used to encode the signal, often data, onto the radio frequency carrier that is to be transmitted. Then the demodulator is used at the remote end to extract the signal from the RF carrier so that it can used at the remote end. As quadrature amplitude modulation is a complex signal, specialized QAM

modulators and demodulators are required [1, p. 373].

QAM modulator essentially follows the idea that can be seen from the basic QAM theory where there are two carrier signals with a phase shift of 90° between them. These are then amplitude modulated with the two data streams known as the I or In-phase and the Q or quadrature data streams. These are generated in the baseband processing area [1, p. 373].

$$s(t) = I(t) \cos(2\pi f_0 t) + Q(t) \sin(2\pi f_0 t).$$

Two resultant signals are summed and then processed as required in the RF signal chain, typically converting them in frequency to the required final frequency and amplifying them as required. The amplitude of the signal varies any RF amplifiers must be linear to preserve the integrity of the signal. Any non-linearities will alter the relative levels of the signals and alter the phase difference, thereby distorting the signal and introducing the possibility of data errors.

QAM demodulator is very much the reverse of the QAM modulator. The signals enter the system, they are split and each side is applied to a mixer. One half has the in-phase local oscillator applied and the other half has the quadrature oscillator signal applied. The basic modulator assumes that the two quadrature signals remain exactly in quadrature.

A further requirement is to derive a local oscillator signal for the demodulation that is exactly on the required frequency for the signal. Any frequency offset will be a change in the phase of the local oscillator signal with respect to the two double sideband suppressed carrier constituents of the overall signal.

Systems include circuitry for carrier recovery that often utilizes a phase locked loop - some even have an inner and outer loop. Recovering the phase of the carrier is important otherwise the bit error rate for the data will be compromised.

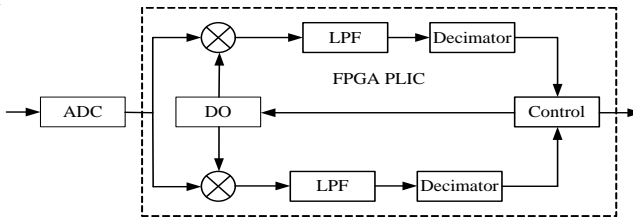


Figure 1 — The QAM demodulation functional diagram

Explanation of symbols:

ADC — Analog digital converter;

DO — Digital Generator;

LPF — Digital Low Pass Filter.



The system includes a parallel high speed ADC required for digitizing the input signal and the PLIC where processing occurs and the signal conversion. Used 256 QAM modulation. Implemented receiving and processing the signal with a spectral of 2 MHz and the possibility of adjustment of the carrier frequency through the computer.

The digital filter used in the project has the following parameters:

- the bandwidth is 2 MHz;
- the unevenness of the amplitude-frequency characteristic in the passband is 0.72 dB;
- attenuation in the fading band is 60.3 dB;
- the filter order is 73;
- the bit depth of the input signals is 24 bits;
- the width of the output signals is 16 bits.

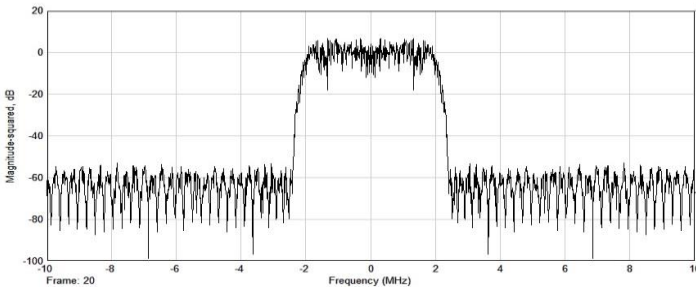


Figure 2 — The filter frequency response

In the development of the circuit diagram, the parameters of the main demodulator cascade elements - ADC with a sampling frequency of 20 MHz and a number of bits equal to 12 bits, a digital oscillator with a 12-bit output capacity, a low-pass filter with a cutoff frequency of 2 MHz and an attenuation outside the bandwidth -60 dB, FPGA are selected and an interface is developed for communication with the computer. The received data completely satisfy the technical task for the diploma project.

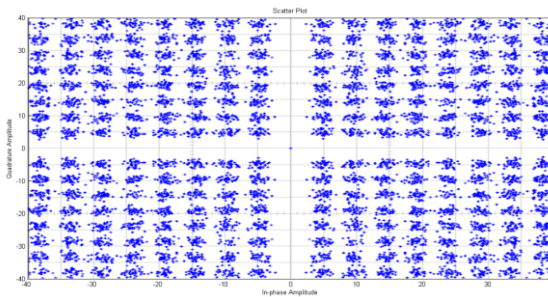


Figure 3 — The results of numerical simulation QAM demodulation

In the course of research, a functional scheme of the quadrature demodulator was developed. A mathematical model for simulating the operation of the system has been created. The elements were calculated and matched and the system operation was simulated with the parameters specified earlier. The results of the simulation, as well as the parameters of the elements, are presented above.

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**Аннотация.** Данный проект посвящён разработке квадратурного демодулятора, на основе программируемой логической интегральной схемы, который предназначен для обработки моделированного сигнала, с последующим преобразованием его в 8-ми битный двоичный код.

Система включает в себя параллельный быстродействующий АЦП, необходимый для оцифровки входного сигнала и саму ПЛИС, в которой происходит обработка и преобразование сигнала. Устройство применимо для демодуляции 256-ти позиционная КАМ. Диапазон частот входных сигналов от 1 до 100 МГц.

**Ключевые слова:** КАМ, ПЛИС, квадратурный демодулятор, цифровые фильтры, цифровые приемники.

**Summary.** This thesis project dedicated to the development of quadrature demodulator based on programmable logic integrated circuits, which designed for processing the simulated signal, with subsequent transformation of it into 8-bit binary code.

The system includes a parallel high speed ADC required for digitizing the input signal and the PLIC where processing occurs and the signal

conversion. 256 QAM modulation, the bandwidth of from 1 to 100 MHz is used.

The design implies the placement of all the elements on one printed circuit board with the possibility of connecting the interface for communication with the computer and the input circuit of the receiver.

**Keywords:** QAM, PLIC, quadrature demodulator, digital filter, digital receivers.

UDC 504.064

**PRINCIPLES OF MONITORING AND SIMULATION AIR FLOW  
CHARACTERISTICS IN THE HARDWARE-SOFTWARE  
COMPLEX  
"SAFE CITY"**

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Integration of information and communication technologies allows you to manage the resources of the city, united in a single economic and ecological system "Smart City". Among the priority functional areas can be identified: energy, transport, water and gas, urban environment, home. In each of these areas, it is possible to single out security tasks and unite the hardware and software that provide them to the "Safe City" subsystem.

The basis for the construction of the "Safe City" are such major groups of technical equipment as security and alarm systems, fire alarm systems, environmental monitoring systems and urban warning systems, as well as analytical video surveillance systems [1].

To implement and operate the system, it is necessary to receive, transmit, process and store a huge amount of information, which requires the coverage of the entire city with 5G and Wi-Fi communication networks,

and fiber-optic communication lines are widely used. Building a secure information transmission channel will ensure the integrity of data and protect the system from unauthorized access.

Modern systems are built on a polycentric principle, which allows you to analyze and process information not only in a single city monitoring center, but also locally - in processing centers distributed throughout the city, and not just on a specific site. In this case, disrupting the operation of a part of the system or its individual channels will not lead to loss of information or loss of the entire system's operability, which ensures its stability and reliability [2].

To obtain primary information, sensors and video surveillance cameras are used. Sensors — converters of changes in the characteristics of the state of the environment including sounds, smells, temperature, movement, into electrical signals. Sensors can be used to collect information about measurements of weather conditions, such as wind speed, air pollution, ozone level, ultraviolet radiation level of the sun. The system can not only collect information and measure the monitored parameters, but also react when a critical level of the parameter is reached, for example, to inform about the critical level of pollution from emissions from industrial complexes. Based on the obtained data, the forecasting of the further development of the situation by means of modeling is carried out.

The purpose of atmospheric air pollution control is to obtain complete information on the qualitative and quantitative composition of the polluted air and its change, which is necessary for predicting the degree of air pollution, the implementation of environmental protection measures, hygienic and toxicological studies.

The tasks of controlling the air environment are:

- analysis of the qualitative composition of atmospheric air pollution and measurement of concentrations of polluting gases;
- control of pollution sources;
- study of the spread of pollutants in the atmosphere and the movement of air currents, leading to global pollution of large regions;
- analysis of the reasons for changing atmospheric composition and air of industrial premises with the aim of justifying and developing air quality standards (maximum permissible concentrations — MPC).

In large industrial centers, the analysis of the city's air environment, conducted on the basis of a "network" of gas analyzers, is relevant. Their main function is to measure the concentration of certain components of the gas mixture in normalized and real conditions, as the level of pollution, for example, in zones of industrial complexes and along large highways exceeds the permissible values by tens of times. Along with the use of

separate gas analyzers, there are entire systems of gas control, which include dozens of gas analyzers of various types. Multicomponent gas analyzers are also known, which simultaneously provide the possibility of measuring the concentration of several gas components in various combinations [3].

In addition to monitoring the current state, information from the "Safe City" system is used for mathematical modeling, the results of which predict and evaluate the state of the air environment. Studies can be based on methods of the theory of remote laser sounding, optical spectral analysis, mathematical apparatus of theoretical radio electronics, methods of fast Fourier transform, methods of numerical simulation. The mathematical analysis is based on the equations of aerodynamics, since the speed of air flows directly affects the spread of pollutants. To model the process of flow around buildings, a mathematical model of separated vortex flows of an ideal incompressible fluid is used or for a simpler case the discrete vortex method. Based on the calculation of the wind speed field, modeling of the dispersion of gas emissions is carried out. It is necessary to take into account that for different chemical components the equations of chemical transformations will be different, and consequently, scattering for different sources of air pollution can differ for the same territory.

Application of the developed hardware and software complex will allow to estimate the size of the affected area and the degree of infection, the composition of the air environment, the parameters of the investigated area, the influence of climatic and meteorological factors. The results of modeling in the "Safe City" systems reflect a dynamic picture of the pollution level directly with reference to geo-information on the map. As a rule, such a system offers a set of measures for normalizing the situation.

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**Аннотация.** «Безопасный город» — комплексная аппаратно-программная городская система безопасности, основанная на инновационных мобильных технологиях и интеллектуальном видеонаблюдении. Внедрение системы газового контроля в данный комплекс, позволит производить контроль загрязнения воздушной среды. На основе полученных данных при помощи моделирования можно производить оценку и дальнейший прогноз экологического состояния города.

**Ключевые слова:** Умный город, Безопасный город, Датчики, Контроль воздушной среды, Моделирование.

**Summary.** "Safe City" is a complex hardware and software city security system based on innovative mobile technologies and intelligent video surveillance. The introduction of a gas control system in this complex will allow to control pollution of the air environment. Based on the data obtained through modeling, it is possible to estimate and further forecast the ecological state of the city.

**Keywords:** Smart city, Safe city, Sensors, Air monitoring, Simulation.

UDC 504

## THE METHOD OF DYNAMIC TRACKING OF MOVING OBJECTS IN WAREHOUSES

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**Introduction.** In warehouse and other production rooms, or in places where a large number of various objects settles down, there is a need for their expeditious identification and tracking. One of ways of the solution of this task is use of specialized radio-frequency tags [1].

However the solution of a task significantly becomes complicated in case of an arrangement of objects at several levels of the conveyor, a warehouse rack, a packing container, etc. The technique allowing to monitor change of provision of objects to within coordinates of discrete level at which they settle down is given in the report.

**Main part.** The objective is solved by installation over each rack with regiments of the separate antenna and reader of a code of tags (further the reader) [2, 3, 4]. In fig. 1 the block diagram of a complex which carries out receiving and data processing is shown.

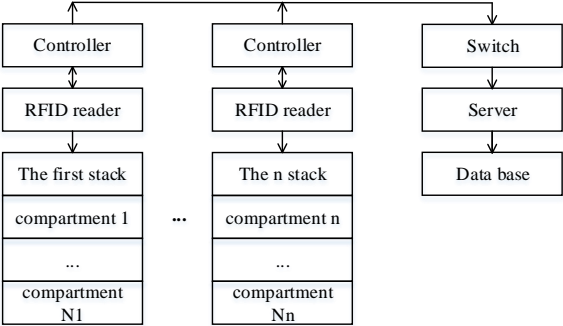


Figure 1 — The block diagram of a complex

The problem of automatic tracking of location of objects is solved by chosen configuration. It is important that with increase in the size of the room it isn't required to make increase in power of the reader as power depends only on the number of levels on a rack and its total height.

Reading of a condition of provision of tags happens after each movement of a compartment of a rack. Control of the reader is exercised by means of the controller which starts scanning at any action with a compartment.

The received results of each scanning get on the controller which forms a package of data and sends him on local network to the database for further processing. Access to all elements of a complex is implemented on IP network, the server application realizing saving data on requests from controllers of separate racks operates work of all elements [5, 6]. If necessary access with use of the wireless protocol IEEE 802.11 standard is possible. The algorithm of work of a complex consists in the following.

When filling compartments with objects, the system automatically carries out filling of the database. In case of movement of a compartment scanning of all of objects available for this purpose is made. The program intended for scanning data processing compares identifiers of tags which are defined before movement of a compartment, with tags which are found after scanning. The result of accumulation of answers is analyzed and made addition or an exception of tags of the general list.

If after opening and closing of a compartment new unique tags have appeared, or any tag lacks, the system notifies that the tag has left a rack or on a rack the new tag has appeared.

Analysis algorithms of filling of compartments are given in the report during work.

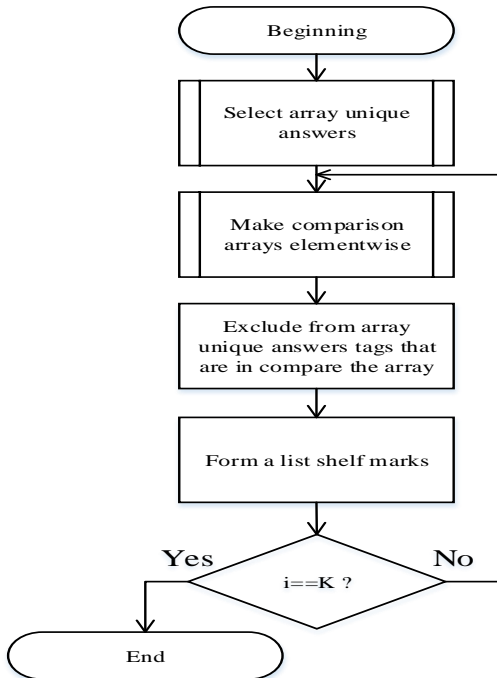


Figure 2 — The general principle of calculating the position of objects

The algorithm in Fig. 2 shows the general principle of calculating the position of objects on  $N$  racks. For further calculations it is necessary to obtain a one-dimensional array of unique answers *Unique*. It contains all the labels on the rack, which were answered at least once.

The method of obtaining this array is shown in Fig. 3. We write the very first element of the source data array  $M$  as a unique. Next, compare it with the rest of the array elements and if such an element has not been previously encountered, then add it to the list of unique labels. Perform this comparison until all the marks in the array  $M$  are over.



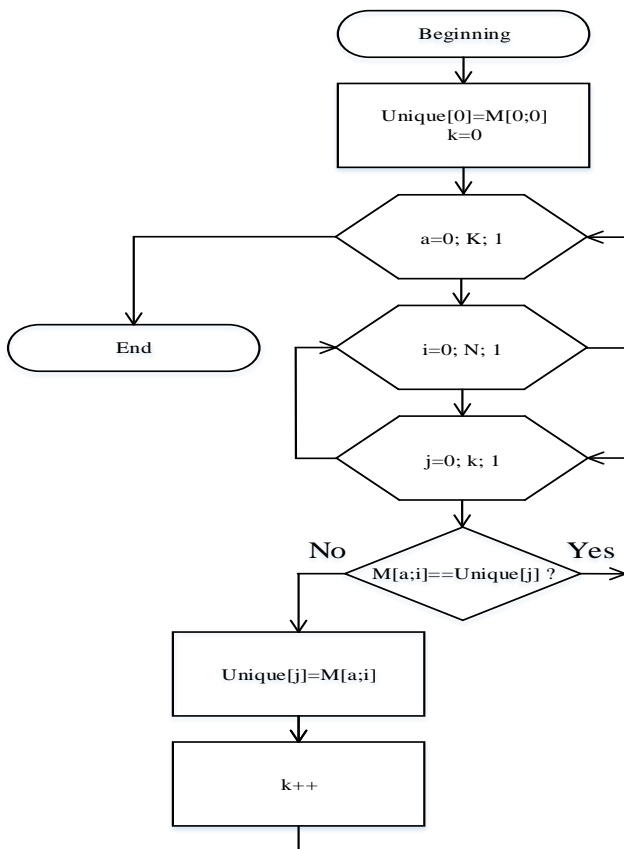


Figure 3 — Algorithm for obtaining an array of unique answers Unique

Now that we have a one-dimensional array with unique elements, we compare it with the original data array. In it each line is measurements without the  $i$ -th shelf on the rack. Select one row from the array and all elements that do not match the array unique count for the elements that were on this shelf. The calculation algorithm for each shelf is shown in Fig. 4.

The results of comparisons are reduced to a new two-dimensional array Result. Each line of this pattern contains labels that are on this shelf.

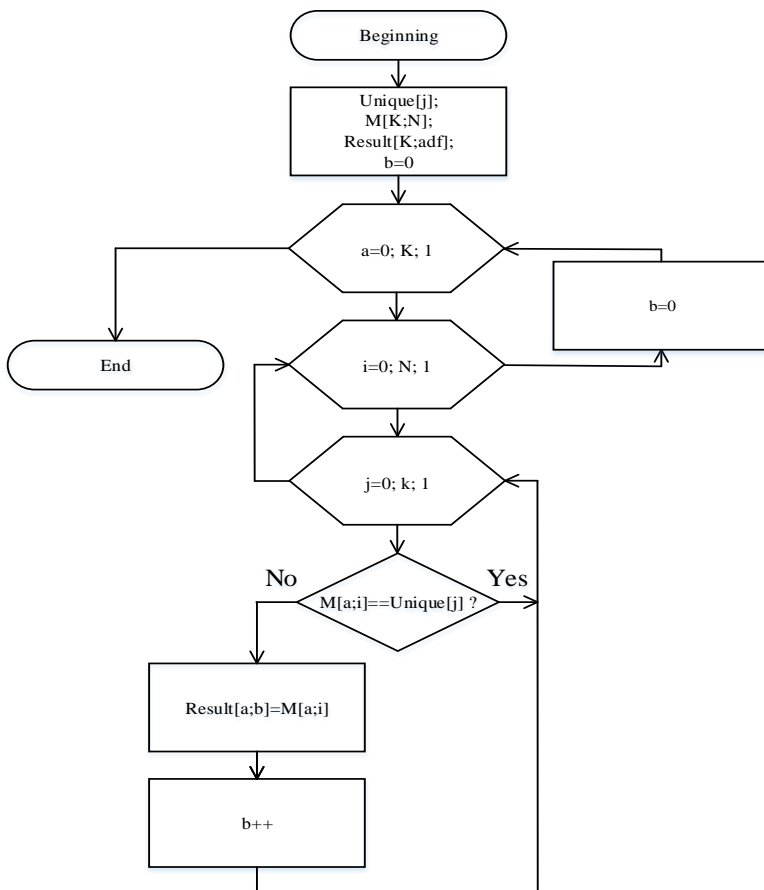


Figure 4 — The algorithm for determining the level position of the labels

**Conclusion.** Thus, the technique of work of a hardware and software system and an algorithm of data processing is developed for dynamic positioning of the objects equipped with radio-frequency tags. The possibility of minimization of operating level of power and increase in accuracy of positioning by a direct arrangement of the scanning antenna over each rack with compartments is revealed. It is important that the offered technique can be used for any options of realization of systems of radio-frequency identification.

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**Аннотация.** В докладе рассматривается вариант реализации программно-аппаратного комплекса для отслеживания положения объектов, размещенных в регулярных многоуровневых отсеках. Приводятся алгоритмы анализа состава отсеков в ходе работы комплекса.

**Ключевые слова:** технология радиочастотной идентификации, антенна, радиочастотные метки.

**Summary.** The report considers an option of implementing a hardware and software complex for tracking the position of objects located in regular multi-level compartments. Algorithms for analyzing the composition of compartments during the operation of the complex are given.

**Keywords:** technology, radio frequency identification, antenna, RFID tags.

## **SYSTEM ANALYSIS OF A CONDITION OF THE SKIN INTEGUMENT RELEVANCE AND PROBLEMS**

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In the modern world, everyone faced with skin-related problems. Bad ecology and tense rhythm of life adversely affect the condition of the skin, as an element of protection from external influences.

According to WHO (World Health Organization) data for 2015, 22% of the world's population struggle with dermatological diseases. According to informal data this figure approaches 70%, and every year the number of the diseased increases.

Among the most common diseases in Russia one can identify the following: fungus (27 million people), acne (6.3 million people), eczema (2 million people), psoriasis (1.5 million people). Difficulties in diagnostics and treatment are characteristic of them, and late stages of identification can give complications up to threat of life of the patient. Serious problems can arise at a psoriasis, an eczema and stressful acnes which reduce protective function of a skin. On the surface fine open wounds — "gates" for various microorganisms are formed. At dermal infection illnesses which difficult respond to treatment can develop and can even lead to death.

Currently, the treatment of all these diseases requires of a high level medical specialists, as well as specialized medical institutions.

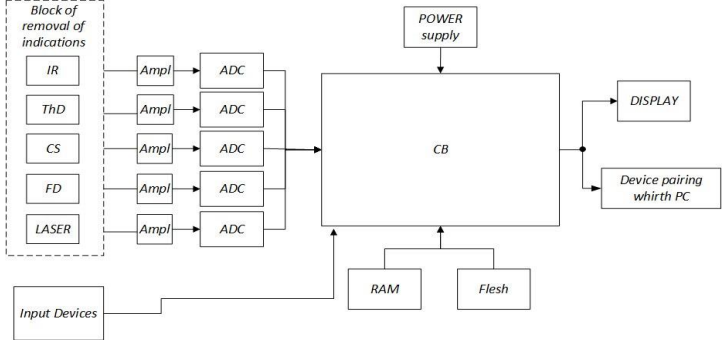
In this regard it is relevant to development of the device capable to define some dermatological diseases and initial stages of their development by medical personnel who do not have dermatological specialization or a high level of training. This problem is relevant for remote regions of Russia.

### **Description of the proposed device and the principles of it is operation**

The device contains components of optical profilometry to get analysis of skin exfoliation and topography, methods of corneometry for measuring water and lipid balance, as well as methods of optical spectroscopy (non-invasive blood analysis) and laser flowmetry (assessment of microcirculation in the skin). The functional scheme of the proposed device is shown in picture 1.

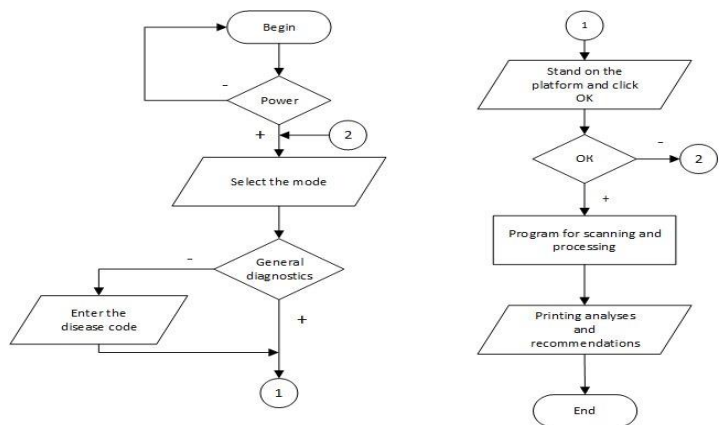
The basis of the device is a control box, it's receives data from the data acquisition devices-sensors (block of removal of indications). Information

from them is amplified processed in converting devices (ADC). The control box runs a data processing program. Results of handling are displayed on the display. There is also a possibility to connect the device via USB-port.



Picture 1 — Functional diagram of the proposed device (the IR detector readings using infrared light, the THD – thermal detector, a CS – corneometry detector, FD- photodetector, the LASER is a laser diode for recording the data through the methods of laser Doppler flowmetry, CB – control box)  
 The algorithm of functioning of the proposed device is presented in the picture 2.

According to an algorithm the device has two main operating modes: a regimen of the general diagnostics (integrity of integuments, an ecdysis, humidity of a skin, temperature, collagen level etc) and a regimen taking into account a concrete disease (selection of analyses). Results of analyses are entered in the virtual database and printed together with the probable diagnosis and references to literature.



Picture 2 — The algorithm of functioning of the proposed device

### **Prospects for the use of the device**

The offered system is capable to carry out the analysis of a condition of integuments without participation of the doctor. The automated working principle is able to define certain skin parameters and assume diagnosis on the basis of this (the final diagnosis is made by the doctor). This will save time of the diagnostics, identify the disease at an early stage, as well as prescribe treatment at the first doctor's appointment.

This device can be used further not only to diagnostics and monitoring of dermatologic diseases. It is also possible to expand its functionality by means of removable and interchangeable modules with software. As an example — an integrated non-invasive blood test.

### **Conclusion**

The functional scheme and algorithm of the system analysis of a condition of the skin integument is introduced. It can be used for the diagnosis and monitoring of dermatological diseases.

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## **THREE-PHASE TRANSFORMER**

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The world of technologies would be almost empty without such device as transformer. We call transformer as static, i.e. without moving parts, the electromagnetic device intended for transformation of one values of parameters of alternating voltage and current into other values of the same frequency. Three-phase current can be transformed by three single-phase transformers or by one three-phase transformer. On each of three cores of the transformer two windings belonging to one phase one of which is primary, and another – secondary are placed. The beginning of the primary windings are denoted by letters A, B, C, and their ends X, Y, Z; for them the beginning of the secondary windings are denoted by small letters a, b, c all x, y, z.

The physical processes occurring in each phase of a three-phase transformer do not differ from those in a single-phase transformer; therefore, the vector diagram of a single-phase transformer can be considered as a diagram of one phase of a three-phase transformer [2, p. 18].

Windings of three-phase transformers can be connected on schemes "star" or "triangle".

We cannot but enumerate the types of connection. There are three main ways to connect the phase windings of each side of the three-phase transformer:

The first way is known to be "Y-connection", the so-called star connection, where all three windings are connected together by one end of each of the windings at one point, called the neutral point or the star.

The second type is "D-connection", the so-called Delta connection, or triangle connection, where the three phase windings are connected in series and form a ring (or triangle).

And the third one is "Z-connection", the so-called zigzag connection

The primary and secondary sides of the transformer can be connected in any of the three ways shown above. These methods offer several different combinations of compounds in transformers with different characteristics, the choice of which can also be due to the type of core [3, p. 25].

It is a well-known fact that the Y-connection is usually a natural choice for the highest voltages when the neutral point is for charging. In any case, for over-voltage protection or for direct grounding, a neutral passing insulator is provided. In the latter case, in order to save the neutral insulation level may be lower than the insulation level of the phase end of the winding. The star-connected winding also has the advantage that the transformation ratio control switch can be provided on the neutral end, where the number of turns switch can also be placed. Therefore, the number of turns switch will be able to operate at a low logical level, and the voltage

difference between phases will also be negligible. In comparison with the expenses spent for installation of the switch of number of turns, at higher level of tension economic costs will be lower.

The star connection is used on one side of the transformer, the other side must be connected by a triangle, especially in cases where the neutral connection by the star is planned for charging [2, p. 19].

As for the triangle winding connection it provides an ampere-turn balance for the zero sequence current flowing through the neutral and each phase of the connection by the star, which gives an acceptable zero sequence impedance level. Without a triangle winding connection, a zero sequence current would produce a zero sequence current field in the core. If the core has three rods, the field from the yoke to the yoke penetrates through the walls of the tank and will lead to the release of heat. In the case of an armored core, or in the presence of five cores of the core, this field will penetrate between the untwisted lateral rods and the full resistance of the zero sequence will increase significantly. As a result, the current in the event of a breakdown on the ground can become so weak that the protective relay will not work.

In the triangle-connected winding, the current flowing through each phase winding is equal to the phase current divided by, while in the star connection, the linear current of each phase winding is identical to the linear current of the network. On the other hand, for the same voltage, the triangle connection requires a triple number of turns compared to the star connection. The triangle winding connection is advantageous to use in high voltage transformers when the current is high and the voltage is relatively low, as for example in low voltage winding in step-up transformers.

The connection of the winding with a triangle allows the third (and multiple) harmonic of the current to circulate inside the triangle formed by three phase windings connected in series. Third harmonic currents are necessary to avoid distortion of the magnetic flux sinusoidal, and hence induced EMF in the secondary winding. The third current harmonic in all three phases has the same direction, these currents cannot circulate in the winding connected by a star with an isolated neutral.

It is worth mentioning that the lack of ternary sinusoidal currents in the magnetizing current can lead to significant distortions of the induced voltage, in cases where the core has 5 rods, or it is executed in the armor variant [3, p. 67].

The transformer winding connected by a triangle will eliminate this violation, as the winding with a triangle connection will provide attenuation of harmonic currents. Sometimes transformers provide for tertiary D-connected winding, which is not intended for charging, but for preventing



voltage distortion and lowering the total resistance of the zero sequence. These windings are called compensatory. Distribution transformers designed for charging, between phase and neutral on the side of the first circuit, are usually connected by a triangle winding. However, the current in the triangle-connected winding can be very weak to reach the rated power minimum, and the required size of the winding conductor is extremely inconvenient for factory production. In such cases, the high-voltage winding can be connected by a star, and the secondary winding-zigzag. When using a pair of windings connection in different ways, it is possible to achieve different degrees of offset voltage between the sides of the transformer [1, p. 65]. The zero sequence currents circulating in the two bends of the zigzag connected winding will balance each other, the total resistance of the zero sequence of the secondary side is mainly determined by the magnetic field scattering between the two windings of the windings, and is expressed by a very small figure.

To sum everything up the transformers application is essential so it is vital to proceed its investigation.

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**Аннотация.** Данная статья посвящена трансформаторам. Известно, что трансформатором называется статическое, т.е. без движущихся частей, электромагнитное устройство, предназначенное для преобразования одних значений параметров переменного напряжения и тока в другие значения той же частоты. Основа трансформатора – две катушки (за исключением автотрансформатора) с обмотками: первичной, подключенной к источнику переменного тока, и вторичной, куда подключается потребитель. Катушки индуктивно связаны, они надеты на замкнутый сердечник, изготовленный из специальной трансформаторной стали. Перечисляются способы соединения в трансформаторе. Описываются их преимущества и недостатки.

**Ключевые слова:** Трехфазный, трансформатор, катушки трансформатора, обмотка трансформатора, автотрансформатор, трансформаторная сталь.

**Summary.** The given article is devoted to the transformers. The transformer is known to be static, i.e. without moving parts, the electromagnetic device intended for transformation of one values of parameters of alternating voltage and current into other values of the same frequency. The basis of the transformer is known to be two coils (except autotransformer) with windings: primary, connected to an alternating current source, and secondary, which connects the consumer. The coils are inductively coupled, they are put on a closed core made of special transformer steel. The types of connection are enumerated. Its advantages and disadvantages are given.

**Key words:** three-phase transformer, transformer coils, autotransformer, transformer winding, transformer steel.

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## **CONTROL AND OPERATING HOUSEHOLD ELECTRIC NETWORKS PARAMETERS SYSTEM**

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Electrical devices are increasingly used, and can harm to human life. That is why the human and equipment protection are the actual problem in electrical engineering development.

Today there are many different protection devices, control units that already include protection. The problem is that there is no one that would satisfy such requirements as cheapness, compactness, speed, reliability.

The simulation results of relay protection module in the Matlab package are shown. It's done to select the optimum mode. The household electrical networks protection device prototype is also presented.

Main accidents in the household electrical network are short circuits, under voltage, voltage dips, overvoltage, high-voltage pulses, electrical noise, total voltage disconnection, harmonic distortion, voltage, unstable frequency.

Overload in the private sector are the most dangerous. It is usual for all consumers to be supplied from the general electric system. Also the

protective equipment designed for short circuit currents in the main. Also in multi-apartment buildings nothing prevents the uncontrolled power increasing.

To household appliances and industrial equipment from voltage surges protect, it is proposed to equip them with the monitoring electricity transmit quality to the power supply device. If the voltage is out of tolerance limit, device will disconnect the protected circuit. Proposed device will protect the circuit from short-circuit, and will also protect against power failures.

The device functional diagram consists of: a central control unit (CCU), a power supply (PS), a redundant power supply, an analog-to-digital converter (ADC), a control unit, an indicating unit, a relay and a sensor.

Circuit modeling and researching in the Matlab Sim-power system are carried out.

The presented device can be protecting the home network 220 V.

All system operating elements which are distribute the energy between consumers in the apartment were brought together (Fig. 1) for modeling in the Matlab working environment. As it shown the circuit consists of four main blocks: the Transformer substation power supply unit, the breaker block, the measurement unit and load block.

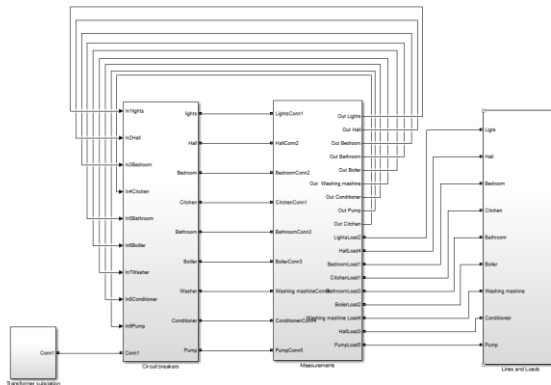


Figure 1 - Energy distribution scheme

To test the model operating, a single-phase short-circuit to earth was created. During the research it was found that the maximum current is 6 A. Protection device prototype in these conditions should be enable till current increase by 7-10 times.

The simulation result is shown in Figure 2. As can be seen from the oscillogram, the short-circuit current did not exceed 70 A.

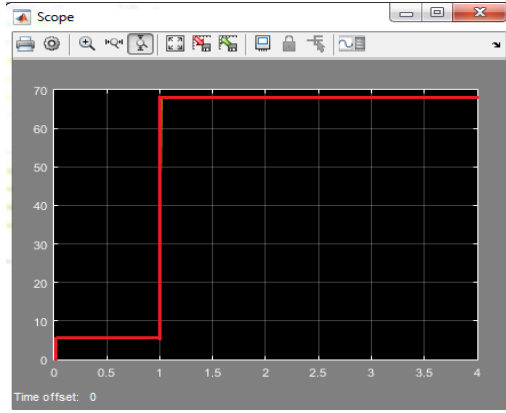


Figure 2 - Short-circuit current oscillogram

The device prototype operates on an inverse curve, which can be calculated by next equation:

$$t = \frac{k\beta}{\left(\frac{I}{I_{>}}\right)^{\alpha} - 1} \quad , \quad (1)$$

$t$  - response time (s);  $k$  - time coefficient which specifies a specific operating characteristic;  $I$  - rated overload current or short circuit;  $I_{>}$  - the overcurrent protection current (calculated parameter), the coefficients  $\alpha$  and  $\beta$  determine the characteristic type, depending on the inversion degree of the current characteristic changes.

The current is 2.8 times greater than the nominal current will be switched off in 0.33 s. It shown in curve in Fig.3.

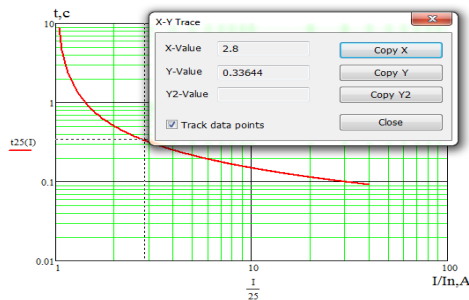


Figure 3 - Time-current(I(t)) device curve

As a result of simulation the oscillogram was constructed (Fig. 4). It seen that the short-circuit current disconnect for 0.3 s. This result corresponds to the standard.

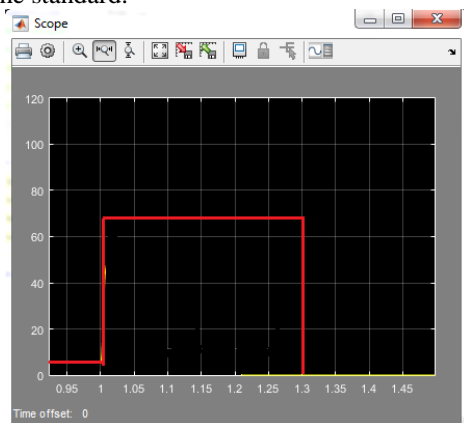


Figure 4 - The short-circuit current tripping oscillogram

The prototype device simulation for household electrical networks protection was presented in the article. The device can be configured for the specific load of the network. The developed device is a reliable and compact integrated relay protection control unit. It had acceptable automatic for emergency use parameters and can be used in practice.

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**Аннотация.** Представлен прототип блока управления для комплексной релейной защиты бытовых электрических сетей 220 В. В статье описано моделирование, и исследование схемы проведено в программе Matlab Sim-power system.

**Ключевые слова:** устройство защиты, короткое замыкание, электротехника, модуль релейной защиты, однофазное короткое

замыкание.

**Summary.** The control unit prototype for complex relay protection of internal electrical networks 220 V. Article describes circuit modeling and researching in the Matlab Sim-power system.

**Key words:** protection device, short-circuit current, electrical devices, relay protection module, single-phase short-circuit.

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## **MICROCONTROLLER DDS GENERATOR DEVELOPMENT**

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As digital technology rapidly develops, a digital generators building becomes possible. Digital generators can generate analog signals based on Direct Digital Synthesis (DDS).

The DDS method allows an analog sinusoidal form signal to generate, with high frequency accuracy. Also, the DDS allows different modulations for the generated signals. Signal modulation allows to modulate a signal's frequency, phase and amplitude.

The DDS method previously was used for military communication systems only. Since, it was difficult to perform high-quality digital-to-analog conversion at high speed rate, which was a cause for high cost of such devices.

With a large-scale integrated (LSI) circuit introduction and manufacturing technologies improvement, a digital synthesis method has become widely used in various industries.

A microcontroller program algorithm allows generating signals with given shape based on the DDS method. The proposed device block diagram is shown in Fig. 1.

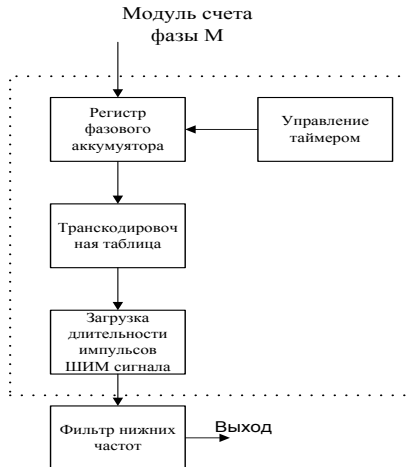


Fig. 1 —DDS-generator block diagram for microcontroller implementation

The base version consist of: phase accumulator (PA), read-only memory (ROM), reference oscillator (RO), digital-to-analog converter (DAC) and low-pass filter (LPF).

It was proposed the PA, ROM and DAC replaced by a microcontroller to simplify the scheme. A PA is a register that increments the value synchronously with the account module. The amplitude values for the corresponding phase values are selected using the transcoding table in the digital n-bit codes form. These codes are transmitted in the pulse durations form to realize the PWM signal.

The modules interaction is represented by the method is organized: as the RO a quartz resonator appears, which generates  $f_C$  - the timer interrupt frequency. A frequency generated transmits to PA. Next, the received value forms the PWM signal. The clock signal frequency can be changed, it allows to control the output signal frequency.

The proposed generator block diagram is shown in Fig. 2.

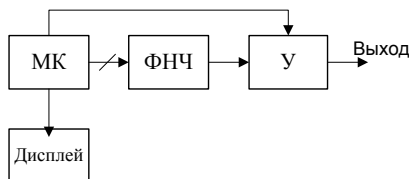


Fig. 2 — The developed generator block diagram

In the base submission PA is a digital device (n-bit counter). It increases the phase value from 0 to  $2\pi$  with the specified counting module M with the clock frequency. Thus, the phase value is linearly increased and fed to the ROM module. ROM contains a table (one period of the sin function) with the amplitude values for the phase corresponding in the digital n-bit codes form. These codes are transmitted to the DAC input. Next, the output voltage changes under the clock signal impact. This changes define the harmonic signal amplitude. Such signals has a high harmonics ratio. This factor can be suppressed by the output LPF. The frequency output signal change  $f_{OUT}$  described by the relationship:

$$f_{out} = \frac{M \cdot f_c}{2^n}.$$

The timer interrupts are used as the frequency  $f_c$ , n-bit register are store the amplitude value with M-counting module.

Thus, the device being designed by the DDS method, will provide a wide frequency range, and will allow the signals with determined shapes to generate.

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**Аннотация.** Разработана структурная схема и принцип функционирования микроконтроллерного генератора. Используется метод DDS для формирования сигналов заданной формы. Этот метод может обеспечить широкий диапазон перестраиваемых частот.

**Ключевые слова:** цифровые генераторы, метод прямого цифрового синтеза, микроконтроллерный генератор, генераторы-модуляторы, перестраиваемые частоты.

**Summary.** The block diagram and the principle of microcontroller function generator are proposed in the paper. A DDS method is used to generate signal with given shapes. This method can provide a wide frequency range.

**Keywords:** digital generators, Direct Digital Synthesis, microcontroller generator, generators-modulators, frequency range.



## **THE PROSPECTS OF THE COAL INDUSTRY DEVELOPMENT IN RUSSIA**

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Russia is the leading country in the world on explored reserves and volumes of extraction of the most important types of minerals. Coal is considered to be the main source of electricity and heat in the fuel and energy balance of the country, its huge reserves in Russia allow us to orient the long-term development of the power industry on the widespread use of coal as a basic strategic fuel that can meet the needs of mankind in fuel for hundreds of years. With the development of coal energy, energy security, as well as the economic and social stability of the country, are to a certain extent related.

Despite the fact that the industry in question was dominant in the 2 technological order, it does not lose its relevance. Coal generation currently accounts for about 40% of electricity in the world. From the economic point of view, the Russian coal industry is today one of the system-forming ones, while it is completely a market branch.

Coal mining for Russia is one of the important components of the economy, since besides providing for domestic needs, coal is a strategically important export raw material. According to the Energy Strategy until 2040, Russia has significant coal resources - more than 4 trillion. tons, a significant part of the resource is in Siberia (64%) and the Far East (30%). About half of the coal produced in Russia is exported, in January-December 2014 it produced 357.33 million tons of coal (1.5% more than in 2013), while Russian coal exports in 2014 amounted to 149.329 million tonnes, tons (which is 8.3% more than in 2013) [1].

Coal is a unique conglomerate from which it is possible to obtain a wide range of diverse and sought-after products: from electricity to space fuels and nanomaterials. The coal mined in Russia contains practically the entire table of DI Mendeleev's elements. Modern technologies make it possible to obtain about 130 kinds of semi-finished products from coal, which can later be converted into more than 5000 useful products. The importance of coal for the country is difficult to overestimate, coal is used as fuel, raw materials are used for the needs of the agro-industrial complex,

for the chemical industry, for the production of products with high added value.

A significant number of certain types of coal goes to coking, which is necessary for the iron and steel industry, and coal of a certain quality is an important export commodity for Russia. Coal is the beginning of the chain for the formation of products with high added value. For example, from 1 ton of anthracite, the cost of which is about 3-4 thousand rubles., You can get 1 ton of carbon sorbent, the cost of which will be 3 million rubles. It is worth noting that the products that are obtained during the processing of coal are especially important. So, for example, the carbon sorbent is used for purification of drinking water, waste water, exhaust gases of industrial and energy enterprises, and this product is also used in pharmaceuticals and medicine [2].

In the bowels of coal basins, not only the world's reserves of solid fuels of mineral resources are concentrated, but also its satellite - methane. It is a gas that is a valuable fossil and is subject to independent commercial production or associated extraction in mines with complex stage-by-stage operation of gas-bearing coal deposits. Coals, which occupy an intermediate position between brown coal and anthracite, are the most promising for methane extraction. It is this coal that lies in Kuzbass, where since 2003 PJSC Gazprom started the implementation of an innovative project for the extraction of coal gas. The extraction of methane from coal seams began in Kuzbass in 2010 at the Taldinskoye field [6].

The volume of methane in the main coal basins of Russia is estimated at 83.7 trillion. cu. m., a special place in Russia belongs to the Kuzbass, which is the largest of the most studied methane-coal basins in the world, the forecast resources of methane are estimated at more than 13 trillion. cu. m. In 2014 in the Kemerovo region at the Taldinskoye field, 11 million 916 thousand cubic meters were mined. gas, which is 62% more than in 2013 (7 million 350 thousand cubic meters). The stable level of methane production in the Kuzbass coal basin is planned at 4 billion cubic meters. m. per year, and in the long term this figure is planned to increase to 21 billion cubic meters. m. [6].

Coal gas is the wealth of Russia, huge resources, world experience, technologies, equipment for extraction and use of methane will allow it in the near future to take a worthy place in the fuel and energy balance of the country. It is important that methane, extracted from coal seams, is the most affordable, cheap, as well as environmentally friendly of all known flammable gases in the world. Favorable geological features and conditions of gas content of the Russian coal basins are an objective prerequisite for the organization of large-scale methane extraction both in passing and

independent mineral resources (primarily in Kuzbass). In Russia, at present, there are regions that are not provided with sufficient gas volumes, so that the coal-producing regions could provide the production and household needs of the regions with gas through large-scale methane extraction from coal seams. In addition, advance degassing of coal seams will allow:

- to increase the safety of the hard work of coal miners in Russia; - To reduce the possibility of forming an explosive mixture of methane and air many times;

- create new jobs, reduce unemployment;
- improve the environmental situation of coal-mining regions;
- Reduce the cost of coal mining in mines, depending on specific conditions by 3-4%.

- increase the investment attractiveness of the industry;

Work in this industry is associated with a serious risk, but labor of miners is very necessary for the normal life support of people, as well as creating conditions for comfortable living. The coal industry employs 148 thousand people and 500 thousand in related industries. Coal enterprises are the city-forming for 31 monotowns totaling 1.5 million people. 50% of electricity in Siberia and the Far East is produced by coal generation. Coal is the number one cargo for railway workers, it provides 39% of the country's freight turnover [2].

Along with new technologies, a competent and thoughtful strategy for the development of production and development of new deposits is important, Kuzbass mines serve as an example of this approach, these coal-mining enterprises are the most efficient and productive in Russia today [5]. The extensive way of development of the coal industry has practically exhausted itself, therefore it is necessary to take coal as a basic component to new markets: chemical products, carbon materials, modern technologies allow to produce more than 130 kinds of chemical intermediates from coal. As a result, a new type of economic activity will be formed in our country, in which fossil Russian coal will be the beginning of a chain of high added value formation [2].

In the course of my research, I singled out the following main promising directions for the development of the coal industry:

- development of coal chemistry (obtaining chemical products from coal);

- coke chemistry (coking coal of a certain quality with the production of metallurgical coke and chemical products);

- production of carbon materials (production of highly profitable nanomaterials from coal);

- electricity generation (new technologies and equipment for environmentally friendly and efficient coal combustion);
- waste processing (return of waste to economic circulation with obtaining of building materials);
- advance degassing of coal seams (obtaining coal gas-methane, reducing accident rates in coal mines) [2, 3].

Thus, coal is an important resource, Russia must use it effectively. Also, solid fuel is an integral part of a sustainable energy balance, a reliable source of foreign exchange and taxes to the budget. Increasing the profitability of the industry can be achieved through large-scale degassing of coal seams, coal enrichment, and also through the production of chemical products with high added value.

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**Аннотация.** В статье речь идет об угольной промышленности в России. Обсуждаются перспективы её развития. Автор отмечает слабые и сильные стороны развития данной сферы. Дается информация об основных угольных бассейнах России. Обсуждается специфика труда в сфере добычи угля. Приводятся важные данные и статистические исследования. Данная статья будет интересна экономистам и людям работающим в угольной промышленности.

**Ключевые слова:** уголь, промышленность, производство, твердое топливо.

**Summary.** The article deals with the coal industry in Russia. The prospects of its development are discussed. The author notes the weak and strong aspects of the development of this sphere. Information about the main coal basins of Russia is given. The specifics of work in the field of coal mining are underlined. Important data and statistical studies are given. This article will be of great interest for those working in the field of economy and coal industry.

**Key words:** coal, industry, to develop, production, solid fuel.

UDC 004.8

## SMART HOUSE SYSTEM

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Internet of Things (next IoT) - the concept of a space in which everything from analog and digital worlds can be combined. This implies that in the future “things” will become active participants in business, information and social processes where they can interact and communicate among themselves, exchanging information about the environment, reacting and influencing the processes taking place in the world around them, without human interference. One of the areas of development of the IoT is the smart house.

Smart house is a system, which deals with automatic control of devices in the house. Main factors of security are water and gas leakage, fire and burglar alarm [1]. System installs for saving the water, gas and electricity too. Seeing increased control of these utilities reduces the cost of their payment. When installing smart house system special sensors for control the current and future expenses are bring established.

There are two main types of smart house system: with a centralized management system and with distributed logic.

First type of smart house system is a system in which the coordination of processes is carried out on the host computer. Process management in such a system occurs directly on this computer by clicking the appropriate controllers, and the monitored device is the executor of set of operations specified on the host computer.

The main advantages of this smart house are:

Program independence of the system from components. Simplicity of creating algorithms, scenarios and definition of emergencies.

Lower costs of resources for the implementation of algorithms than the costs of a system of the second type.

Second type of smart house system is a system that consists of certain smart things, connected in some way with each other. For example: system of smart illuminant – smart switch.

The main advantages of such systems type are:

- independence of system components from central management. This facilitates autonomous operation in case of unforeseen situations.

- less load on processors that process data. This increases the data transfer rate and the operation of algorithms.

Smart house components are selected depending on the needs of the consumer. In the kit can go various sensors, control elements, connecting wires, as well as optional accessories. Conditionally components can be divided into such categories: security, light control, heat, automation, video surveillance, management, entertainment. With smart house systems can be installed the autonomous power supply.

Access control systems for houses and apartments: electric locks (magnetic and mechanical) with the possibility of remote opening. Magnetic lock is easier, cheaper and more reliable. It requires a constant power supply of 12 volts, so before using it is also necessary to provide an uninterruptible power supply unit so that the equipment continues to work even when the electricity is cut off [2].

The electromechanical lock is like a conventional bolt lock, but it can be opened by an electric impulse. Often can be opened with a conventional key.

Access systems in the room is implemented by contact keys ("tablets"), contactless keys ("drops") or contactless magnetic cards. A key reader is installed outside the door, an exit button or another reader is inside. The controller manages the lock by sending an opening signal to it, if the correct key is applied to the reader or the exit button is pressed.

Systems of working hours accounting. It is usually put in the office or at the production. It is built based on special controllers and a computer. The computer stores information about who entered and left the door (or several doors) when and when. Based on this information, you can subsequently receive reports on the time spent by each employee at his workplace.

*Doorphones.* The system is shaved from a panel installed outside on the door, and a doorphone monitor (video intercom). When the visitor calls the intercom, you can chat with the monitor through video surveillance and open the door. The system can have many monitors or call-out doorphone panels.

*Automation of gates and barriers.* The automatic gates include sliding, swinging and lifting sectional doors.

*Managing the Light in a Smart Home.* Management of lighting through the components of the Smart House - one of the most popular areas of automation of an apartment or a country house. An individually designed system will create a cozy home, save energy, pleasantly surprise your guests [3].

The quantity, type and power of luminaires is always chosen based on such factors as the purpose of the room, its color scale, interior, street lighting level and many others.

The algorithm is developed depending on the wishes and personal preferences of the owner of the house: for example, during work, the workplace should be well lit, and during rest it is better not to focus on it. And it always adjusts the work to automatically turn on the workplace lighting when the host approaches a certain time.

When the automatics takes control of the light in the dwelling, the owner can forget about such things as switches - smart light will light up as it approaches and extinguish when leaving. In the evening and at night, the light in the house can be soft and unobtrusive, for a comfortable time or bright, if the owner of the house, for example, receives guests.

Brightness depends on the time of day and the chosen pattern of behavior: in the evening, the brightness of the lighting is always at a comfortable level, at night it will not disturb those who are already asleep but will safely walk around the apartment. From any control panel or handheld computer, you can set the scenario of the lighting system of the

room in which the owner is located, or the entire house, and turn on and off individual groups or determine the intensity of the glow.

#### *Heated radiators under the control of the Smart House*

With the use of radiator heating, smart modules of the Smart House system allow you to precisely adjust the temperature in each room from the computer, the control panel or automatically, according to the active template [4].

Heating is possible with warm water floors or radiators. Thermoelectric actuators are installed on the collector of the warm floor or radiator, which regulate the supply of hot water to the heating circuit. It is possible to individually set the air temperature in each room, as well as use different scenarios.

In conclusion it should be noted that now, the management of an "intelligent" house can be carried out with many devices running iOS, Android, windows.

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**Аннотация.** Дается определение системы "Умный дом". Проанализированы основные виды и преимущества данной системы. Описаны особенности интеллектуальных модулей системы "Умный дом".

**Ключевые слова:** домофоны, система " Умный дом", радиаторное отопление, интеллектуальный "дом", термоэлектрические приводы.

**Summary.** The author gives the definition of Smart house system. Main types and advantages of smart house system are analyzed. The features of smart modules of the Smart House system are described.

**Keywords:** doorphones, Smart House system, radiator heating, intelligent" house, thermoelectric actuators.



## SECTION 2 INFORMATION SYSTEMS



UDC 621.39

### INVESTIGATION OF IP-TELEPHONY SYSTEMS OVER THE INTERNET IN LABORATORY WORKSHOP

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**Introduction.** In the modern world IP-telephony develops more and more actively [1, p. 477]. Her advantages in front of ordinary wire phones lead to the fact that at the market there is a big variety of producers both special equipment rooms of the device, and software products which provide services to IP-telephony [2, p. 475].

**Main part.** It is possible to use hardware decisions generally on the SIP protocol, and also program options for the personal computers (PC) and mobile devices. Now a large number of program options is practically used: Skype, WhatsApp, Viber, Telegram, Mail.Ru agent, Raidcall, Discord, Team speak, Mumble, etc. Briefly we will characterize the most known programs of IP-telephony:

1) Skype — the free software with the closed code providing text, voice and video conference on the Internet between computers optionally using technologies of P2P networks.

2) Telegram — the free cross-platform messenger for smartphones and other devices allowing to make calls and to exchange text messages.

3) Raidcall — the computer program developed especially for voice communication by means of VoIP technology.

The system wich used in work for a research of characteristics of channels is represent in Fig. 1.

Are a part of measuring system: two personal computers connected to the Internet; the generator connected to the first computer; two millivoltmetr, one of which measures generator tension, the second - tension at the personal computer exit; oscillograph; the range analyzer connected to the second computer.

On two personal computers by means of the IP-telephonies programs voice connection was established. For an example we will consider characteristics of the channel of the Telegram program. As an example in Fig. 2 shows the Skype (a) and Telegram (b) programs during a communication session.

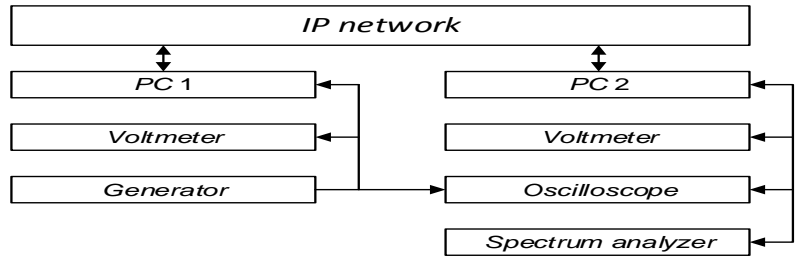


Fig. 1 — Structural scheme of the system

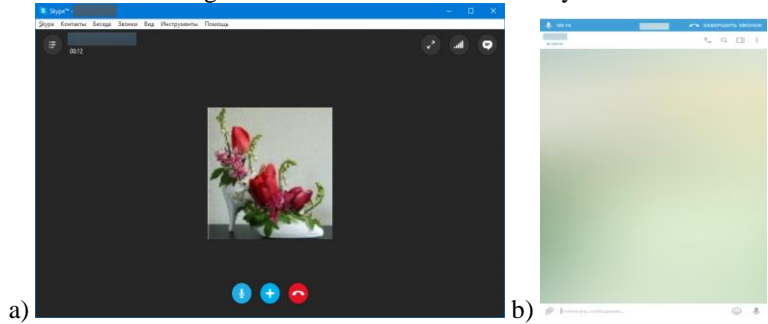


Fig. 2 — View programs Skype (a) and Telegram (b) during a communication session

For example, Fig 3 shows the spectrograms of the test signal in the communication channel of the program Raid-call at frequencies 1 kHz (a), and 4 kHz (b). The results show that the test signal generator provides a signal-to-noise ratio in the frequency range up to 10 kHz of the order of 40...60 dB, which allows a study to determine the signal distortion in the communication channel.

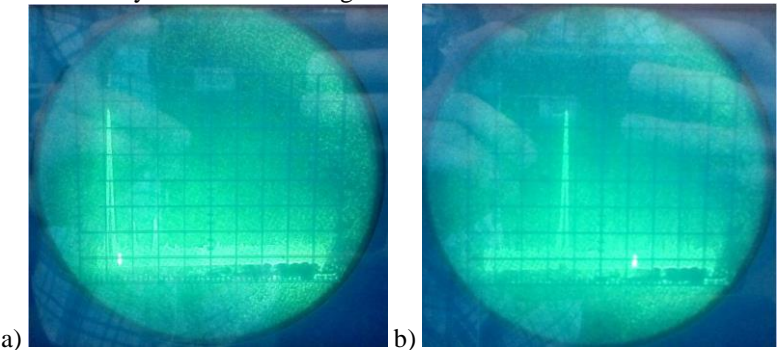


Fig. 3 — The spectrogram at frequencies of 1 kHz (a) and 4 kHz (b)

In Fig. 4 the amplitude characteristic of a communication channel at three values of frequency is represented: 1 (— —), 3 (.....) and 5 (---) kHz.

Amplitude-frequency characteristics of the through channel for programs of Raidcall (---) and Telegram are provided on Fig. 5 (— —).

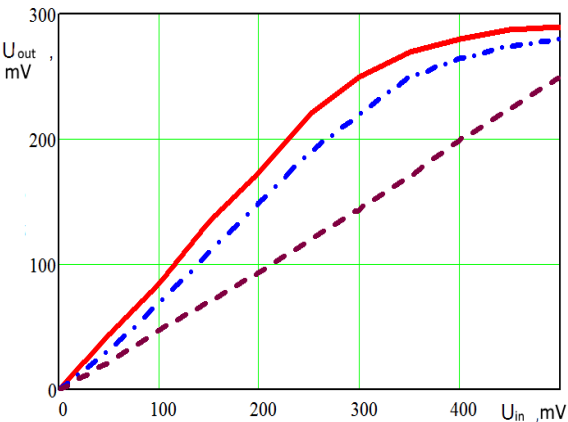


Fig. 4 — Amplitude characteristic of the communication channel at three frequency values: 1(— —), 3 (.....) and 5 (---) kHz

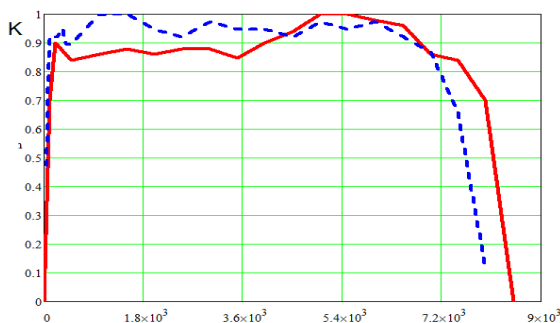


Fig. 5 — Amplitude-frequency characteristics of the through channel for programs Raidcall (---) and Telegram (—)

The result of experiments is shown that characteristics of the IP-telephonies systems provide transfer of a strip of frequencies about 6,5 ... 7,5 kHz. The amplitude characteristic in the range of frequencies differs from linear that is a consequence of use of systems of automatic adjustment of strengthening.

**Conclusion.** During the executed research the general features of implementation of modern programs for transfer of voice traffic on the Internet are defined, and the general tendencies of development of this direction are defined. Results of a research of characteristics of the IP-telephonies programs are given in the report.

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**Аннотация.** В докладе рассматриваются особенности исследования канала IP-телефонии. Представлены характеристики каналов связи для различных программных вариантов и выполнено их сравнение.

**Ключевые слова:** IP-телефония, средства связи, приложения для звонков.

**Summary.** In the report features of a research of the channel of IP-telephony are considered. Characteristics of communication channels for various program options are submitted and their comparison is executed.

**Keywords:** IP telephony, means of communication, applications for calls.

UDC 004

## **INFORMATION TECHNOLOGIES IN THE MANAGEMENT OF PERSONNEL ON THE EXAMPLE OF EXPERT SYSTEMS**

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Every company that wants to survive in a highly competitive environment should constantly improve its operations. In this case, it should pay close attention to the rational use of all types of resources at the disposal of the organization. The staff of the organization is one of the most important resources, because exactly with the knowledge, skills and skills it is the key to the successful activity of the organization.

Continuous development of personnel, the search for new methods for managing it - the necessary attributes of a successful operation of the company.

Modern possibilities of automation of business processes and personnel management functions, advanced information and computer technologies, which are available for HR departments, allow to optimize and rationalize the management function with the help of the newest means of data collection, transmission and processing [1]. One example of this kind of innovation is Expert systems.

Expert systems (hereinafter ES) are software complexes that accumulate knowledge of specialists in specific subject areas and replicate them for advising less qualified users [2].

Simply put, these systems provide an opportunity for the manager / specialist to receive expert advice on any issues about which the system has accumulated knowledge.

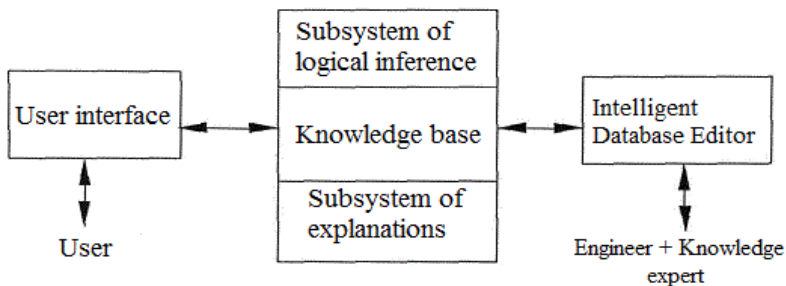
The subject areas of ES are many: commercial, financial, medical, military, etc. Every year the scope of application is expanded, and the number of users is increasing.

The following ES functions in personnel management are distinguished [3]:

- performance of computer psychophysiological examination and testing of workers;
- conducting vocational guidance, vocational training, hiring;
- staff reduction;
- performance of attestation;
- obtaining recommendations on the most effective use of each employee in the conditions of a particular enterprise;
- creation of profiles of professions and positions;
- evaluation of the suitability of the employee, compatibility of the «team», etc.

It is important to note that the result of the work of expert systems is unknown in advance, since the course of the reasoning algorithm is built on the current dialogue with the user, and the solution is determined by his answers. It is possible to say with confidence that the ES was the first step in the creation of artificial intelligence.

The structure of the classical expert system is shown in picture 1 [2]:



Picture 1. Architecture of the expert system

According to the picture, the core of the system is the knowledge base, which is a set of knowledge in a certain field, in this case in the field of personnel management, personnel records, which is recorded on the computer medium.

To fill the core with knowledge, it is necessary to find experts - high-level practitioners in this subject area (problem, field of activity). Usually there are tens, hundreds and thousands of experts.

Getting knowledge from an expert (experts) process is not easy. This is a whole scientific direction in the field of artificial intelligence - knowledge engineering. The knowledge engineer is the link between the expert and the knowledge base. He gets knowledge from experts, then he identifies key concepts, relationships and characteristics necessary for describing the process of solving a problem, structures this knowledge and chooses a way to represent them (model) for the subsequent filling of the core of the system [2].

Models of knowledge representation can be different: production, logical, semantic network, frame model, etc. A production model is considered to be widespread, where knowledge is represented in the form of certain rules formulated on the basis of expert knowledge in the form: IF (condition), AND (action), THEN (action).

Let us give an example. The management of many companies when hiring employees appoints them a probationary period. But there are exceptions. For persons under the age of 18, this restriction does not apply. Therefore, the rule describing this situation in the knowledge base of the following kind [2]:

- IF: select the hiring operation
- AND: the age of the employee is under 18 years of age
- THEN: the trial period is not established.

Thus, the user (the HR manager) enters the original data into the system and receives a response.

In addition to the knowledge base, there are other elements in the expert system:

- subsystem of logical inference, simulating the course of «reasoning» of the system;

- user interface - a program that allows you to conduct a user dialogue with the expert system at the stage of entering information and at the stage of obtaining results;

- subsystem of explanations - a program that allows the user to get an answer to the question: «How and why did the system come to this decision?» (developed subsystems support other issues);

- intelligent database editor - a program that presents a knowledge engineer with the ability to create a database online.

There is the following classification of ES for work with personnel [2]:

- multifunctional systems (tasks to be solved: vocational guidance, vocational selection, employee certification, reserve formation, competencies, etc.);
- systems for the group analysis of personnel status (strategic tasks: analysis and optimization of the structure of the organization, determining the development trends of units, etc.);
- systems for professional psychologists (identification of negative manifestations of employees, including criminal inclinations, hidden conflicts, negative trends in divisions and the organization as a whole).

The most famous ES are described in table 1 [4].

Table 1 – Famous Expert systems

<b>Name</b>	<b>Characteristic</b>
CLIPS	Very popular shell for building ES (public domain).
OpenCyc	A powerful dynamic ES with a global ontological model and support for independent contexts.
WolframAlpha	Knowledge base and set of computational algorithms, intellectual «computing engine of knowledge».
MYCIN	The most well-known diagnostic system, which is designed to diagnose and monitor the condition of a patient with meningitis and bacterial infections.
HASP/SIAP	Interpretation system that determines the location and types of vessels in the Pacific according to acoustic tracking systems.
IBM Watson	A supercomputer from IBM, able to understand the questions formulated in natural language, and to find answers to them in the database.

The most popular domestic software complexes are the Staff Service and Personnel Consulting (the developer of the Etalon NGO, Moscow), the intellectual psychological research system PSY (the developer of SAINTEX, Moscow), and others.

Summing up all, it can be concluded that information technologies at the enterprise participate in the improvement of management, and this, in



turn, affects the activities of the company as a whole. Expert systems are the tool for working with personnel, on the basis of which many important management tasks are solved: explaining and justifying recommendations and opinions about employees, acquiring new knowledge, determining the level of competence in relation to the task, etc.

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**Аннотация.** В статье раскрыта сущность экспертной системы, как одного из эффективных информационных инструментов управления персоналом. Описаны ее основные функции в управлении кадрами организации, стандартная структура и сферы применения. Кроме того, приведена классификация экспертных систем для работы с персоналом. На основе имеющихся данных проанализированы самые известные экспертные системы (зарубежные), а также описаны популярные отечественные программные комплексы.

**Ключевые слова:** информационные технологии, кадровая деятельность, управление персоналом, решение управленческих задач, экспертные системы.

**Summary.** The article reveals the essence of the expert system as one of the effective information tools for personnel management. Its main functions in personnel management of the organization, standard structure and spheres of application are described. In addition, the classification of expert systems for work with personnel is given. Based on the available data, the most known expert systems (foreign ones) are analyzed, and also popular domestic software systems are described.

**Keywords:** information technologies, human resources, personnel management, management tasks, expert systems.

## **BIG DATA AND BLOCKCHAIN SYNERGY**

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Nowadays nobody will be surprised by big data amounts and its rapidly growth. Social networks, measuring devices, meteorological data are only small part of all available to generate more and more data sources of information. Picking and analysis gathered information is priceless object for close attention not only for science and business, but also for government. One of the common reasons is the ability of making really genuine decision taking in attention previous experience, the ability of objective market analysis with the further setting priorities. Nevertheless, the traditional methods of gathered information analysis were found to be ineffective because of the strong difference in information formats (such as photo, music, video or plain text). As a result, companies could have data, but did not have the tools for making relations between them, so they were disable to male important solution based on it. For solving gained problems Big Data were designed.

Big Data is a complex of tools and methods for structures and unstructured huge amount and variety data analysis. The cause of getting Big Data in all ranges of human activity is rapid IT development and principally new methods of it using. According to Robert Half International Inc, lots of companies are confused by analyzing big data amounts.

Main Big Data principles:

Volume. A larger number of data sources with larger data sizes causes the growth of the amount of data needed for analysis;

Variety. The result is useful only when the minimum delay of information processing;

Velocity. The information comes in all possible formats (sound, video, text, etc.);

Reliability. In addition to the increasing speed and variability of the data, the collection and processing process should have a zero error;

Complexity. Information comes from a variety of sources, making it difficult to transform and compare information between systems.

Work with big data amount has next principles:

Horizontal scalability. There should be extensibility of the processing system depending on the increase in the processed data, for example, in the case of an increase in the amount of data by 2 times, the amount of iron in the cluster will increase by 2 times;

Fault tolerance. According to horizontal scalability, a cluster can contain many machines. This implies the release of their failure. Methods of working with data should allow such failures and continue to work correctly;

Local data. In large distributed systems, data is stored on different machines. In the case of finding data on one device and processing on the other – the cost of transferring information may exceed the cost of their direct processing. To avoid this, it is advisable to store and process data on the same machine.

Depending on the latest Accenture, GE and IBM researches it is able to speak about formidable big data analytics on business. Nearly 92% of directors are fully satisfied by researching results and its influence on their business, nearly 89% marked analytics as an important part of optimizing business process. Without no doubts, it is the revolution in the business world.

In 2015 in analytics report KPCB analytic Mary Miker gave full picture of internet changes during the last decades. So, cost of computer calculating and data storage became cheaper, also Big Data helps companies in reducing consumption.

10 main Big Data ranges are:

Marketing. Now this is the most popular place to implement Big data. Big Data is used to understand customers' behavior and preferences. One of the most significant results of Big Data application was the appearance of contextual advertising;

Business. Sellers are able to optimize sales of products based on forecasts made taking into account trends among search queries, weather forecasts;

Personal development. Each of us can benefit from the information received from the wearable device (e.g., smart watches or fitness bracelets). Using the information obtained, we can optimize our daily regimen, diet and even physical activity;

Healthcare. Based on the analysis of patient information, it is possible to identify both the most appropriate medicine and to determine the cause of the disease with high accuracy. It is also possible to determine the reaction of the body to a particular drug and draw the appropriate conclusions. Thus, Kaiser Permanente studied in detail the formation of blood clots in women

who took oral contraception. In the process, it was found that one of the drugs increases the risk of blood clots by 77%;

Sport. Big Data is used to monitor and study the athlete in order to improve its performance;

Science. Experiments produce huge amounts of data, which will later be discussed in detail;

Industry. Big Data helps machines and devices become smarter and more self-contained. One of the many examples can be an unmanned vehicle, which is equipped with cameras, GPS, various sensors and powerful equipment for analyzing the information received and responding quickly to changing conditions;

Security. Big Data is used not only to prevent crime, but also to catch the offender;

Administration. Big Data is used to optimize certain resources. For example, in the case of traffic management, it becomes possible to optimize traffic, based on the received information in real time;

Trading. In this field, Big data algorithms are designed to make decisions about trading;

Despite the obvious pros, Big Data also has cons:

high price;

ethical character;

problem of analyzed data choice;

data authenticity;

Problem of analyzed data choice and data authenticity can be solved by combination of Big Data and Blockchain. Blockchain is a way of data storage and digital transactions list. In other words, it is a way of store everything in separate independent record with further checks. Its main feature and undoubted advantage is storing list in different places. Every its user can have access to an actual list version, what makes it clear absolutely for all its members.

Blockchain provides ideal conditions in data management range – information from trusted source and all details about it. Blockchain opens new possibilities not only for business, but also for IT industry which supports and optimize business operations. By the words of general SAP Labs manager Andrew Bevetski, Blockchain operates with hardware, such as clouds and physical memory without data. It allows to separate software platforms not only for data management controlled by Blockchain but also for its further analysis by app request. Confidence in information will be grows up as the Blockchain using range will be wider. It is supposed to use Blockchain technology in clouds overall. Nowadays cloud storages are centralized, what makes users to entrust their data only to the one service

provider.

Also Blockchain is able to prevent crimes because of data clarity provided by this technology. It allows to use in ordinary case, but all suspicious data will be in a tick tracked.

There are two types of Blockchain – open and private. Networks based on Blockchain can without any extraneous help track all important data and protect it from any dangers. Open Blockchain is based on all user`s consensus. It means that all users should decide on which data they rely on. In private Blockchain only some users are able to make decision concerning data authenticity.

By the worlds of IT-manager Swiss financial holding UBS Oliver Bussmann, Blockchain is able to reduce the time for handling transaction from days to minutes.

Common usage Blockchain and Big Data can be successfully used in healthcare. It is common knowledge, that incomplete and deficient data of patient`s health can rise risks of the wrong diagnosis. All necessary patient data should be highly protected, be immutable and checked.

Blockchain provides checked data which can be used in Big Data without no doubts concerning its guarantee. Also due to the Blockchain all organisations and companies would be able to deal with each other with authentic data.

Information is a precious assets. It means that its security should have the highest priority. To survive and succeeded in business companies should go along with time and use all possible opportunities and advantages provided by Blockchain and Big Data.

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**Аннотация.** Сегодня информация является самым ценным активом во всех сферах жизнедеятельности человека. Она способна изменить мир в долю секунды. В этой статье рассматриваются причины обретения столь пристального внимания у данных и то, какие манипуляции с ними могут происходить с целью достижения более выигрышных показателей.

**Ключевые слова:** IT-технологии, Блокчейн, криптография, информационная безопасность.

**Summary.** Today, information is the most valuable asset in all spheres of human life. It can change the world in a split second. This article discusses the reasons for gaining so much attention from the data and what manipulations can occur to achieve winning performances.

**Key words:** IT-technologies, Blockchain, cryptography, information security.

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## **AUTOMATIC FREQUENCY COUNTER VERIFICATION COMPLEX**

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### **Introduction**

In our days many measuring devices in development stage and operation process of all radio systems is used. All measuring devices requires periodic verification in order to confirm the conformity of instruments with metrological characteristics. Verification process usually is made by verification engineer in specially laboratory. In this case, there is a probability of error when engineer is connecting measuring devices or sets their settings. It leads to incorrect results of verification.

Main idea of this work is to create the automatic verification complex using the frequency counter as an example. Such complex allows to exclude the possible errors and significantly decreases human factor in verification process. Also using of this complex allows to reduce the time spent on verification of measuring devise. This is particularly relevant for large verification laboratories, where every day dozens of instruments are tested.

As a result of analysis of existing systems for instruments verification automation the following requirements being established for the system are set:

- for controlling all measurement devices system should contain personal computer with installed special developed program;
- system should consist of relatively novel devices to ensure the correspondence of transmitted data between personal computer and other devices;
- software should have a user-friendly interface;
- language of the software must be in Russian;
- integrated development environment must be free.

Methodic for verification of frequency counters is the basis for developing of complex.

Designing of complex is performed on base Engineering Center of Micro- and Nanoelectronics devices, Sevastopol State University.

### **Overview**

Complex for automation of verification process consist of hardware and software part. Hardware part contains personal computer (PC) or laptop, checked frequency counter and all needed instruments and accessories for verification. All devices of hardware part are connecting at PC through USB, COM or LAN interfaces [1, p.10]. If any of devices have a GPIB interface and do not have USB, LAN or COM (or there is no possibility to controlling devise thru this interfaces), the interface converter must be use [2, p.41]. One of the possible verification complex appearance is shown in figure 1.



Figure 1 — Appearance of verification complex

As seen in the figure 1, laptop is used for controlling the verification procedure (in the right side of figure). All instruments are connected to the network via a router. Checked frequency counter connected to laptop by GPIB-USB interface converter [3, p.5].

When instruments connecting to the router, two mode of IP-addresses settings are possible:

- in automatic mode, which requires set the DHCP mode in settings of all instruments;
- in manual mode, which requires set the unique IP-address in settings of all instruments.

When automatic mode is used, DHCP mode must be enabled in settings of router.

Preferable is manual mode, because in this case probably of instruments connect failure are decrease. Used for complex network should not contain other devices, that do not apply in verification procedure. In addition, this network must be local (should not have connection to the Internet). These requirements necessary for exclude the chance of data packet losses in network, which can lead to errors in the verification procedure.

If interface converter in system is used, on PC must be installed package of input-output libraries or appropriate driver. Also on PC must be installed the last version of Java SE platform for correct work the developed software. The operating system on PC can be Windows, Linux, MAC or another that supports Java virtual machine.

### Developed software

In figure 2 main window of designed software for verification complex is presented.

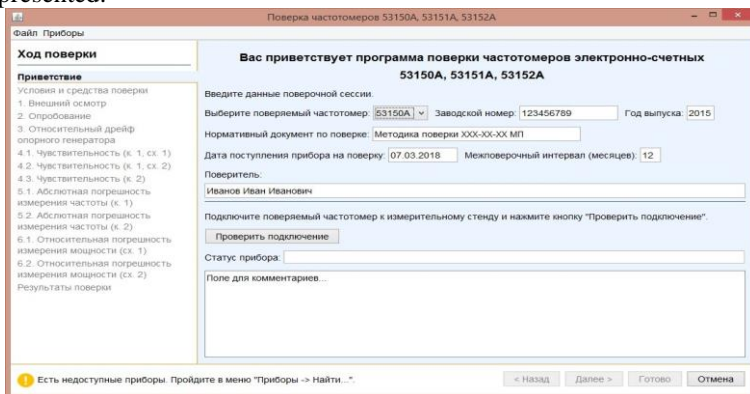


Figure 2 — Main window of designed software

Main window of designed software consist of menu bar (at the top of the window), verification steps list (at the right side), current step panel (at the center of the window), status bar and control buttons (at the bottom). Panel that contains all necessary labels, text fields and buttons for set the



settings presents each step of verification procedure. After filling all fields and assignments all necessary settings, user presses "Start" button and software in automatic mode perform verification procedure step.

Developed software allows to automatic find all available measuring instruments in the network and get their addresses (figure 3).

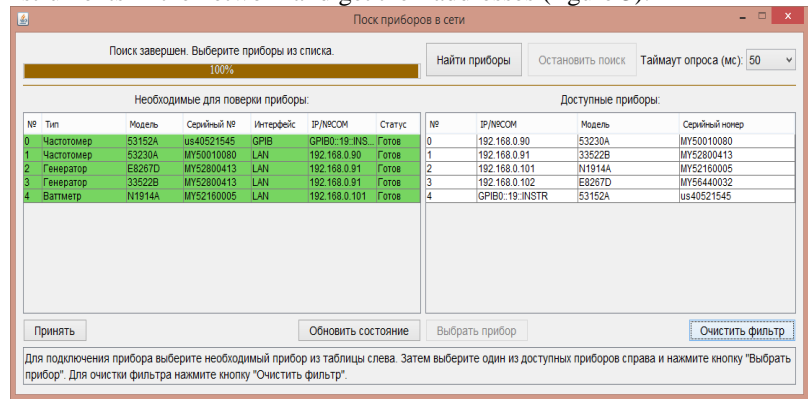


Figure 3 — Instruments search form

Instruments search form is performing check all IP-addresses in the net-work, all COM and USB ports in the PC and determines what devices are present in the system, after which fills the available instruments table (in the right part of window). User can see all necessary instruments in the left table. After filling table in the right side of window, user selects all instruments and press the button "Accept". Information about selected instruments are transmit to the main window of program.

After determining the address of all available devices program step by step guides the user by verification procedure. User does not execute configuration of instruments but only performs their connection. Every verification stage contains a user-friendly connecting devices scheme (figure 4). Settings for all devices are set by the program [4, p.217].



Figure 4 — Connecting devices scheme example

After connection of instruments user must only start test and wait for its result. If result of test is positive, program going to the next stage of verification. The finally decision about suitability of instrument is based on results of all verification procedure stages.

After passing all tests in the program, the report in PDF format is creating. Report contains all information about checked device and verification stages.

### **Conclusion**

The paper presents automatic frequency counter verification complex. Designed hardware and software parts combine to the complex, which provides automatic verification procedure for frequency counter. Designed complex is the basis for creation similar complexes for any measurement instruments.

The developed software has the following features:

- implementation on Java, which makes its use multiplatform, with the support of the Java virtual machine.

- automation of all stages in accordance with the verification procedure, which leads to a significant reduction in the time required to verify the frequency meter;

- possibility to connect devices using Ethernet, COM or GPIB interfaces;

- automatic search of available devices in the network;

- elimination of the influence of the human factor on the results of verification;

- user-friendly interface and instruments connection schemes;

- automatic generation of a report on verification of the installed form with all data in PDF format.

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**Аннотация.** В статье представлен аппаратно-программный комплекс для автоматизации поверки частотомеров электронно-счетных. Измерительный стенд разработанного комплекса (аппаратная часть) включает в себя персональный компьютер, поверяемый частотомер, все необходимые для проведения поверки приборы и метрологическую оснастку. Управление процедурой поверки осуществляется при помощи специального программного обеспечения, разработанного на языке *Java*.

Комплекс позволяет автоматизировать все этапы поверки частотомера, что приводит к значительному уменьшению времени, необходимого на поверку, а также к устранению влияния человеческого фактора.

**Ключевые слова:** Поверка, частотомер, автоматизация, комплекс, программа.

**Summary.** The article presents hardware-software complex for automation of frequency counter verification process. Measuring stand of developed complex (hardware part) includes personal computer, checked frequency counter and all needed instruments and accessories for verification. Verification process is controlled by special software, that = developed in Java.

Designed complex allows to automate all stages of verification process. That leads to significant increasing of time that needed for verification and excludes the human factor.

**Keywords:** verification, frequency counter, automation, complex, program.

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## WIMAX ANTENNA WITH OPERATED POLARIZATION FOR INFORMATIONS SYSTEMS

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## 1. Introduction

Characteristics of modern innovative information systems are usually determined by the characteristics of their antenna systems. At construction of WiMax systems often there is a necessity for fuller use of the polarization properties of an electromagnetic field that defines a creation problem of antennas with operated polarization of radiation. Special cases are the antennas forming a linear radiation field and circular polarization. The traditional solution of the given problem is based on use of three-orthogonal antenna system from electric dipoles with the device of their peak-phase excitation [1, 2]. A deficiency of such antenna is complexity of implementation three-channel ampliphase antenna system as a whole. Also it is necessary grounded to choose angular distances between branches and phases of currents of these branches. It is necessary for decrease cross-polarization for a field component at formation of orthogonal aspects of polarization and as consequences for communication distance raise.

In the given work possibilities of broadband creation antenna with operated polarization of radiation field on the basis of conic spiral structure are investigated, and also the optimum angular distance and conditions of branches excitation of a conic spiral is found out.

## 2. Main part

The aim of this paper is a ground choice of angular position and value of initial currents phases of conical spiral antennas consisting of three identical branches located on the shield. Branches must be opened out in relation to each other in order that the type of radiation polarization changed at the change of initial current phase. As a prototype a conical equal step spiral emitter is chosen with next geometrical parameters that were it is reasonable chosen in [3,4]:

$\theta_0 = 12^\circ$  – conical base angle;  $n = 5$  – conical emitter turns number;  $r_{\max} = 5,4$  sm. – bigger radius of conical spiral emitter;  $r_{\min} = 1,7$  sm. – smaller radius of conical spiral emitter;  $H = 16,8$  sm. – conical spiral emitter height.

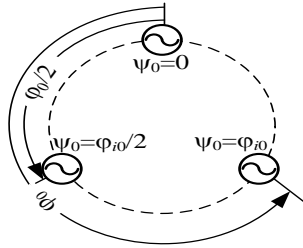


Figure 1 – Chart of excitation three-branch conical spiral antennas accepted at the calculation radiation characteristic.

For the reasonable choice branches angular position and initial currents phases it is necessary to make a modeling. However at the direct decision of this task an objective function contains six independent entry parameters, three parameters correspond to angular position of each of three branches, and three parameters correspond to the initial current phases of these branches, that complicates the decision of task substantially, therefore for simplification it is necessary to decrease the amount of parameters to two. For this purpose we will fix angular position of the first branch equal 0, and angular position of the third branch we will put equal to  $\varphi_0$ , the angular parameter, then angular position of the second stopping will be equal  $\varphi_0 / 2$ , thus three entry parameters turn out tied to the angular parameter  $\varphi_0$  as represented on a fig. 1. Initial the phases of current  $\psi_0$  of each of branches by analogy are tied to the angular parameter  $\varphi_{0i}$ . Thus six entry parameters are taken to two angular parameters  $\varphi_0$  and  $\varphi_{0i}$ . At a mathematical modeling an angular parameter  $\varphi_0$  (according to a fig. 1) changed in limits from  $-248^\circ$  to  $232^\circ$  with a step  $30^\circ$  so a research range is divided on 17 points.

Angular parameter  $\varphi_{0i}$  (see a fig. 2) responsible for the initial phases of each branches changed in limits from  $-240^\circ$  to  $240^\circ$  with a step  $30^\circ$  so a research range is divided on 17 points.

Logically it would be angular parameter responsible for angular position of branches also to change in limits from  $-240^\circ$  to  $240^\circ$ , in this case at equality, branches intersect his zero, that results in the error of modeling, therefore made decision the turn-down of this angular parameter is moved on 8 degrees.

As a result of analysis optimization curves allowing on preset parameter of radiation characteristics it is reasonable to choose geometrical configuration of three-branch conical spiral antenna are got. On a fig. 2 dependence of axial ratio of three-branch conical spiral antenna is represented on a parameter  $\varphi_0$  responsible for angular position of stopping and parameter  $\varphi_{0i}$  of responsible for the branch initial currents phase.

On graphic arts on a horizontal axis  $\varphi_0$  values, are set aside and on the vertical axis of value  $\varphi_{0i}$ . The values of axial ratio in decibels are represented as contour lines. On graphic arts there are zones where axial ratio more than 0,7 that testifies to the presence of circular polarization radiation. On graphic arts the constrained squares are mark areas where probably there is a radiation with meeting direction of vector rotation of the radiation field.

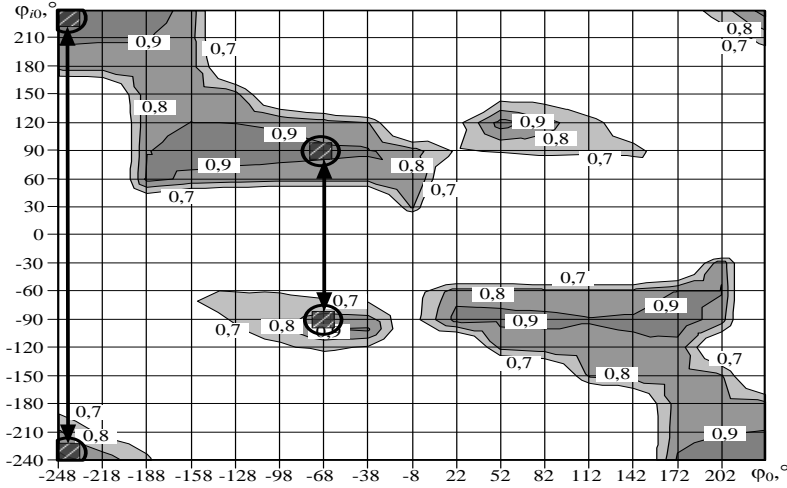


Figure 2 – Axial ratio dependence from angular position and initial current phase of three branches conical spiral antenna.

To define direction vector rotation of the radiation field it is necessary to analyze equation

$$A(\varphi_0, \varphi_{0i}) = 20 \log \left( \frac{E_r(\varphi_0, \varphi_{0i})}{E_l(\varphi_0, \varphi_{0i})} \right).$$

On a fig. 3 dependence  $A(\varphi_0, \varphi_{0i})$  of direction rotation of the radiation field of three branches conical spiral antenna is represented on a

parameter  $\varphi_0$  responsible for angular position of branches and parameter  $\varphi_{0i}$  of responsible for the initial current phase.

Thus if  $A(\varphi_0, \varphi_{0i}) > 0$  that is observed radiation with right-hand polarization. If  $A(\varphi_0, \varphi_{0i}) < 0$  that is observed radiation with left-hand polarization. Circumferences are distinguish zones with the right-hand rotation of the field of radiation :

- at angular branch position  $0^\circ, -124^\circ, -248^\circ$  and according to the initial current phases  $0^\circ, -120^\circ, -240^\circ$ ;
- at angular branch position  $0^\circ, -34^\circ, -68^\circ$  and according to the initial current phases  $0^\circ, -45^\circ, -90^\circ$ .

Also circumferences are distinguish zones with the left-hand rotation of the radiation field vector:

- at angular branch position  $0^\circ, -124^\circ, -248^\circ$  and according to the initial current phases  $0^\circ, 120^\circ, 240^\circ$ ;
- at angular branch position  $0^\circ, -34^\circ, -68^\circ$  and according to the initial current phases  $0^\circ, 45^\circ, 90^\circ$ .

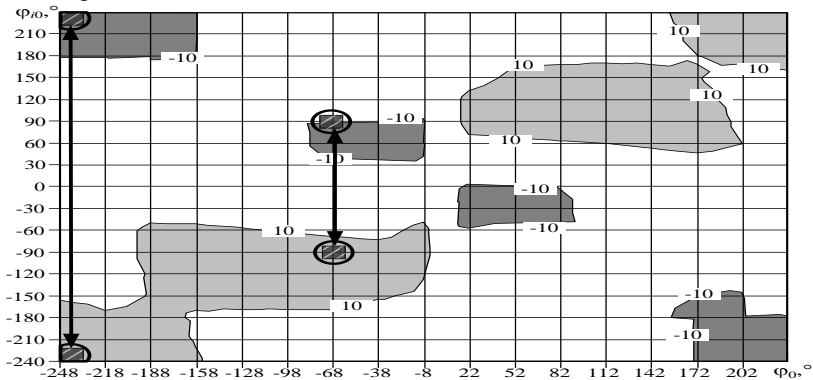


Figure 3 –  $A(\varphi_0, \varphi_{0i})$  dependence on angular position and initial current phase of three branches conical spiral antenna.

Thus, changing only the initial currents phases it is possible to change direction rotation radiation field vector.

On a fig. 4 the radiation pattern of three branches conical spiral antenna are represented in a circular base at angular branches position  $0^\circ, -34^\circ, -68^\circ$  and the chosen initial phases. At initial phases  $0^\circ, -45^\circ, -90^\circ$  (fig. 4, a) there is a radiation of circular right-hand polarization here, the left-hand polarization constituent of the field is eliminated. At initial phases  $0^\circ, 45^\circ, 90^\circ$  (fig. 4, b) there is a radiation of circular left-hand polarization here, the right-hand polarization constituent of the field is eliminated.

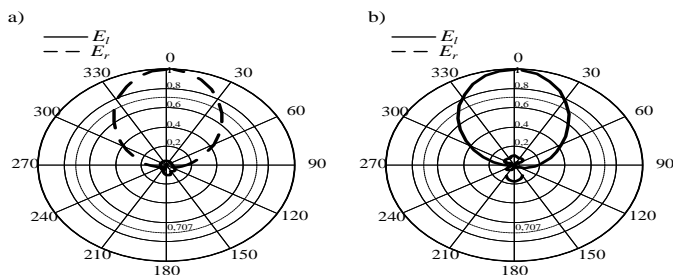


Figure 4 – Radiation pattern of three branches conical spiral antenna at angular position of branches  $0^\circ$ ,  $-34^\circ$ ,  $-68^\circ$  and excitation of branches a current with initial phases: a)  $0^\circ$ ,  $-45^\circ$ ,  $-90^\circ$ ; b)  $0^\circ$ ,  $45^\circ$ ,  $90^\circ$ .

On a fig. 5 the excitation device functional diagram is represented at angular position of branches  $0^\circ$ ,  $-34^\circ$ ,  $-248^\circ$ . For realization of switching of initial currents phases ( $0^\circ$ ,  $-45^\circ$ ,  $-90^\circ$ ) / ( $0^\circ$ ,  $45^\circ$ ,  $90^\circ$ ) it is necessary to use two phase shifters with the fixed values of phases change  $45^\circ$  and  $90^\circ$ . It is yet necessary to use two bistatic phase shifters with values  $0^\circ$  /  $-90^\circ$  and  $0^\circ$  /  $-180^\circ$ .

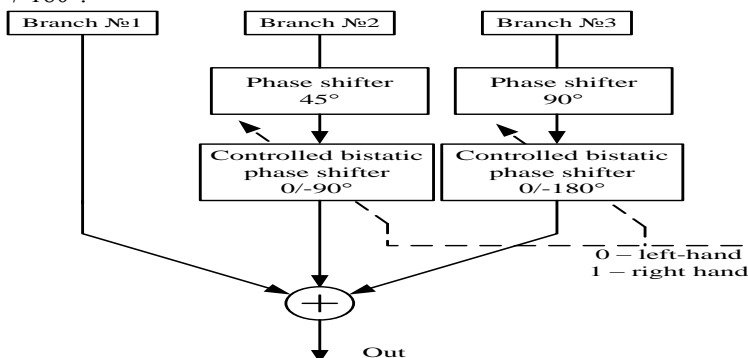


Figure 5 – Excitation device functional diagram at angular position of branches  $0^\circ$ ,  $-34^\circ$ ,  $-68^\circ$ .

### 3. Conclusions

Thus, the worked out antenna at the certain terms of excitation is capable, it concordantly to accept both the field right-hand and left-hand radiation circular polarization.

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**Аннотация.** Получены новые конструктивные варианты WiMax антенны с управляемой поляризацией поля излучения на основе трехзаходной конической спиральной антенны. Обсуждаются результаты математического моделирования, на основе которых выбраны оптимальные геометрические параметры излучателей.

**Ключевые слова:** коническая спиральная антенна, управляемая поляризация, трехзаходная антенна, WiMax antenna.

**Summary.** The new construction variant of the WiMax antenna with operated field polarization on a basis three-branch conical spiral antenna is offered and realized. Results of mathematical modeling are considered, optimum geometrical parameters of radiators are chosen.

**Keywords:** conical spiral antenna, polarization control, three-branch antenna, WiMax antenna.

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## **PROGRAM SYSTEM FOR DEVELOPMENT AND STUDY OF PARSERS**

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Compilers constitute an essential part of software. This is due to the fact that high-level languages have become the main tool for program development. Only a very small part of the software, which requires special efficiency, is programmed with the help of assemblers. A lot of programming languages are now common. When developing compilers for programming languages, the grammar of the source language is often changed. Any correction of the grammar entails serious consequences, expressed in the need to change the control table or program. Accordingly, the more rules the language contains, the more complex and time-consuming this process is. The parser is one of the important parts of the compiler.

Most of the known methods of parsing belong to one of two classes, one of which combines top-down algorithms, and the other - bottom-up algorithms. The origin of these terms is related to how the nodes of the syntactic tree are constructed: either from the root (axioms of the grammar) to the leaves (terminal symbols) or from the leaves to the root.

Descending parsers build a conclusion, starting from the axiom of the grammar and ending with a chain of terminal symbols. With the descending parsers are associated the so-called LL-grammars, which have the following properties [1]:

- they can be analyzed without refunds;
- the first letter L means that we look at the input chain from left to right scan;
- the second letter L means that the leftmost derivation is constructed.

The popularity of downstream parsers is related to the fact that an effective descending parser can easily be constructed manually, for example, by the method of recursive descent [1]. The advantages of LL-parsers are also [1]:

- less time-consuming process of developing control tables compared to LR (1);

- better visibility of the development process;
- simpler estimation of the correctness of the obtained intermediate and final results.

On the other hand, ascending parsers can analyze more grammars than descendants, and therefore it is for such methods that there are programs that automatically build parsers. In ascending parsers, LR-grammars are widely used. With the help of LR-grammars, you can determine the majority of currently used programming languages.

Proceeding from the above advantages and disadvantages of methods of parsing, the choice is made in favor of LL (1) -parsers, since the process of their development is more visual and less laborious. This makes it easier to compare the final result obtained with the help of the developed automation system for the development of parsers, and the expected, obtained manually.

To simplify the development of the parser in the context of frequent corrections in grammar, tools were developed to automate the development of the parser block.

For more effective organization of the educational process on the discipline "System Software" a software system was developed to automate the construction of parsers that allows:

- significantly reduce the time spent on developing parsers;
- significantly reduce the number of errors in the development process.

The software system implements:

- Building a control parsing table based on the source grammar of class LL (1);
- parsing the input chain of lexemes;
- determines the dependence of the parser operation time on the length of the input chain and the volume of the input grammar.

The structure of the developed software system is shown in Figure 1.

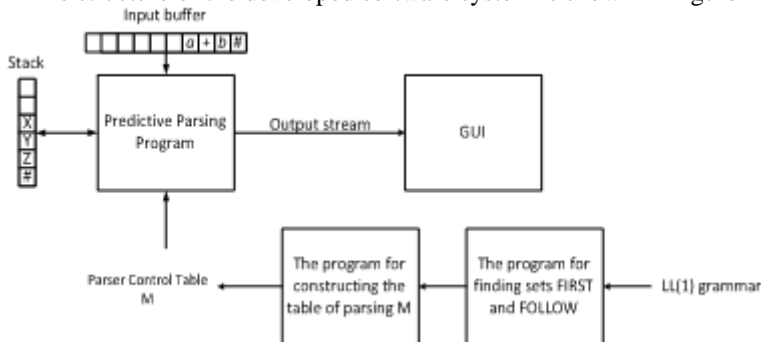


Figure 1– Structure of the software system

The program system contains the following modules:

- Graphical interface;
- the module of the parsing;
- module for generating the control table M;
- module for searching for FIRST and FOLLOW sets.

The "Graphical interface" module is of an auxiliary nature. It contains a text-field for entering grammar, and also supports the ability to open a text file with a grammar.

The interface module is represented by the GUI.java class and contains methods for creating and managing a graphical interface window, as well as input and output methods for input and output data, respectively.

To implement the parser on the basis of the LL (1) method, the module "Non-recursive predictive parser" was developed. Its main control unit is the parsing table. In addition to it, the parser contains a stack for a sequence of grammatical symbols, an input buffer, and an output stream. The key functions in constructing the parser control table are FIRST and FOLLOW [1]. The predictive parsing module realizes the algorithm given in [1]. As a result of the operation of the module, the output stream of the parser is passed to the interface.

The parser module is represented by the class LL1.java. It contains the following methods and functions:

- main (String args) - to run the software;
- method parse (String input) - realizing the algorithm of the predictive parser. Input data is a string.

The control table generation module is represented by the Control\_table.java class. The class contains the following methods and functions:

- void start (HashMap <String, String> grammar) - method to start the generation of the control table. The method parameter is the HashMap collection, in which the input grammar is represented;
- void method setM (String rule, String NT) - method of generating the control table. Fills the relevant cells of the table with the necessary products. The parameters of the method are products and nonterminal, from which the products are produced;
- String function getRuleByTerminal (String line, String t) search for a product (output chain or sentential form) output from nontermin, by terminal symbol. Parameters of the function are products and a terminal symbol. The returned result is the output chain, the first character of which is terminal t.

The module for finding the sets FIRST and FOLLOW is represented by the class First\_follow.java. Contains the following methods and

functions:

- the main (HashMap G) method of starting the FIRST search for all grammar rules and FOLLOW sets for annihilating grammar rules;
- getFirst (String token, String n\_t) - searches for the FIRST set for a single token. The parameters of the method are the nonterminal token character and a string that contains nonterminal symbols for which the FIRST set is already being built;
- the getFollow (String token, String n\_t) method searches for the FOLLOW set for a single token. The parameters of the method is a non-terminal token character and a string that contains nonterminals for which the FOLLOW set is already being built;
- function Set <String> getFirst\_n (String rule, String root) search for the FIRST set for rule. Parameters of the function is the production rule, as well as the non-terminal root, from which the output rule is output;
- searchNullRules () - a method for finding annihilating rules (rules that can spawn empty strings);
- searchStartSymbol () - method of searching for the start character.

To assess the effectiveness of the software system for the automation of the development of parsers, we apply the following method:

- for several training grammars we will form control tables manually;
- We use these learning grammars as input data for the developed software system;
- compare the time of work of parsers built manually and with the help of the developed software system.

Let's consider an example of research of dependence of time of work of the parser on length of an entrance chain for the following fragment of grammar of educational programming language ASPLE-3:

1.  $\langle S \rangle \rightarrow \text{While } V \text{ Do } \langle \text{OpSequence} \rangle \text{ End}$
2.  $\langle \text{OpSequence} \rangle \rightarrow \langle \text{Op} \rangle \mid \langle \text{Op} \rangle \langle \text{OpSequence} \rangle$
3.  $\langle \text{Op} \rangle \rightarrow O \mid \langle \text{OpSequence} \rangle$

The fragment represents the loop operator with a precondition. In this grammar:

$\langle S \rangle$  - loop operator,  $\langle \text{OpSequence} \rangle$  - sequence of operators,  $\langle \text{Op} \rangle$  - operator, V is a logical expression

There are several abbreviations:

"W" - "While", "D" - "Do", "Seq" - "OpSequence", "E" - "End".

For the LL (1) parser, the grammar should not contain left-recursive rules and alternative rules starting with the same character. Rule 2 contains alternative rules that begin with a non-terminal symbol  $\langle \text{Op} \rangle$ . Therefore, it is necessary to convert the second rule as follows:

1.  $\langle \text{Seq} \rangle \rightarrow \langle \text{Op} \rangle \langle X \rangle$

2.  $\langle X \rangle \rightarrow \epsilon$
3.  $\langle X \rangle \rightarrow ; \langle \text{Seq} \rangle$

A comparative analysis of the time dependence of the parsers on the length of the input grammar chain of the ASPLE-3 language was conducted on a laptop with the following characteristics: processor-Intel core i5 4200m, RAM-DDR3 1666 MHz volume 6 GB, hard disk Western Digital 1 TB. Input data for the tests is the sequence wvd [wvdoe] e \$ (wvdoe is repeated from 10245 times to 163840 times, each time the number of repetitions is doubled). The results of testing parsers are shown in Figure 2 and in Table 1.

Analyzing the obtained values of the dependencies of the time of operation of parsers on the length of the input chain with a small number of grammar rules, we can draw the following conclusion: a predictive parser built automatically with the help of a developed software system is faster. Acceleration compared to the state machine is due to the use of Java collections. A moderated collection of the Google Guava Table, which allows you to use two keys for one value, makes it possible to quickly obtain the required value from the control table.

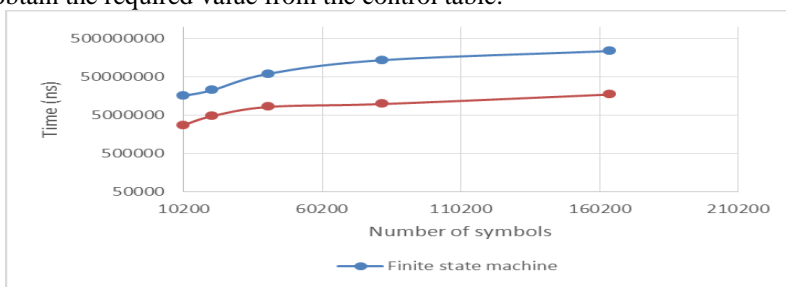


Figure 2 – Graph of the dependence of the processing time of the input line on its length

Table 1. Results of testing parsers

String length	Simple parser time (ns)	Predictive parser time (ns)
10245	16195024	2793771
20485	22681983	4757826
40965	61467027	8321783
81925	138794898	9894998
163845	240205106	17463839

Possible applications of the software system:

- visualization of the development processes of parsers;
- rapid development of the parser in conditions of frequent changes in grammar in the development of programming languages and, accordingly, compilers, translators and interpreters for them;
- analysis of programming languages in development environments;
- analysis of query languages to databases.

The software system is developed in the Java high-level programming language in NetBeans IDE 8.2 using standard language libraries, as well as the Google Guava library.

Improving the algorithms used, the use of more sophisticated and fast data structures will make it possible to increase the efficiency of the program system. Adding interactive tasks to the user interface for fixing the theoretical bases of parsing by the LL (1) method, as well as tasks for building the sets FIRST and FOLLOW will help students to learn the basics of parsing.

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**Аннотация.** В статье рассмотрены средства синтаксического анализа, описан процесс разработки, принципы работы, состав и возможности программного комплекса для разработки и исследования синтаксических анализаторов. Рассмотрен пример исследования зависимости времени работы синтаксического анализатора от длины входной цепочки для фрагмента учебного языка программирования, а также произведено сравнение производительности двух реализаций синтаксических анализаторов.

**Ключевые слова:** синтаксический анализ, компиляция, компиляторы, трансляторы, интерпретаторы, методы синтаксического анализа, конечный автомат, LL- грамматика.

**Summary.** The article considers the means of parsing, describes the development process, the principles of work, the composition and capabilities of the software package for the development and study of parsers. An example of the study of the time dependence of the operation of the parser on the length of the input chain for the fragment of the learning programming language is examined, and the performance of the two implementations of the parsers is compared.

**Keywords:** syntax analysis, compilation, compilers, translators, interpreters, parsing methods, finite state machine, LL-grammar.

**METHODS OF COMBINATORIAL OPTIMIZATION  
FOR RESEARCHING OPTIMAL URBAN ROUTES  
FOR SCHOOL BUS**

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In the modern world the transport infrastructure bears a most important role, for it ensures the livelihoods of the population and directly affects the quality of life. Many vital processes of human life depend on the organization of transport logistics.

With the development of transport infrastructure it becomes necessary to pay close attention to ensuring road safety, since the road is a major source of danger not only for adults, but for children especially. Today, the majority of parents simply have no time to take their child (a primary school pupil) to school, so the child is forced to get to school by themselves. This is highly risky and hazardous, because children have no developed sense of danger when it comes to moving traffic.

This leads us to a certain aspect of ensuring road safety, which is the issue of providing safe home-to-school-to-home transport for pupils. The problem can be solved by wide introduction of the «School bus» program in urban transport system for public educational institutions.

The purpose of the school bus is to take children from home to school and vice versa in an organized way. It remains the safest means of transport for children. According to the statistics, every day 24 million pupils around the world are taken to school by school buses. But before implementing this program, it is necessary to research different routes of transporting children to schools with an aim of their optimization.

Let us formulate the problem. State organization, which is responsible for the execution of the «School bus» program, is assigned to arrange the transportation of pupils from appointed places (bus stops) to schools. There



are  $m$  buses, each is attached to a particular school. The bus should set off from the school, visit  $n$  bus stops in order to collect the pupils and then come back to school to drop off the pupils. The number of bus stops is determined by school administration based on statistical data. Transport expenses for the transportation of pupils are stated. The main part of those is the amount of fuel  $c$ , which is spent on transportation. All pupils must be delivered to school with minimum total costs, which means that for each bus a route with minimum fuel consumption must be found.

The task should be represented in the form of a mathematical model in order to allow the use of the mathematical apparatus. The most suitable would be to describe a task using graph theory. Let the graph contain  $n$  vertices where  $i = \overline{0, n}$ . The vertices of the graph are the bus stops where the bus should collect the pupils. The zero vertex (school) is the start and the end position. The school bus begins movement from this zero vertex and returns to it. Vertices are connected by oriented edges, which represent the ways from the vertex  $x_i$  to the vertex  $x_j$ . Every oriented edge has a weight that describes the relation  $c_{ij} = l(x_i, x_j)$ . The weight is the amount of fuel expenses that are spent on the movement from the vertex  $x_i$  to vertex  $x_j$ . The described graph is shown in the picture 1.

This task is related to the type of tasks known as the «traveling salesman problem», which is one of the most famous problems in combinatorial optimization. The purpose of the task is to find the most profitable route, which passes through given cities at least once and then returns to the initial city.

Let's describe a mathematical model of the task.

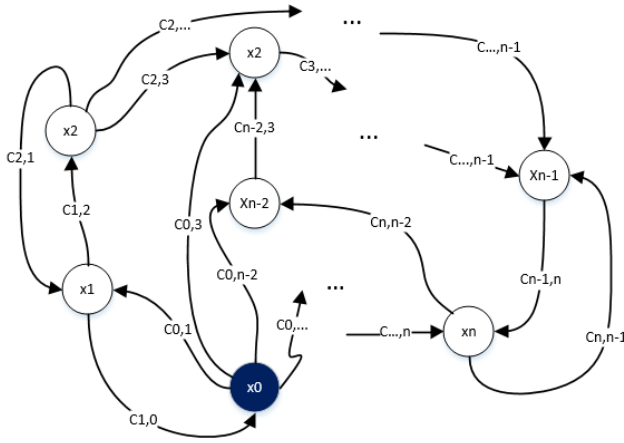
The variables of task:

$$x_{ij} = \begin{cases} 1, & \text{if the school bus is moving from bus stop } i \text{ to bus stop } j \\ 0, & \text{otherwise} \end{cases}$$

The matrix of costs is presented in table 1.

Table 1 – The matrix of costs

	$X_0$	$X_1$	...	$X_{n-2}$	$X_{n-1}$	$X_n$
$X_0$	—	$c_{0,1}$	...	$c_{0,n-2}$	$c_{0,n-1}$	$c_{0,n}$
$X_1$	$c_{1,0}$	—	...	$c_{1,n-2}$	$c_{1,n-1}$	$c_{1,n}$
...	...	...	—	...	...	...
$X_{n-2}$	$c_{n-2,0}$	$c_{n-2,1}$	...	—	$c_{n-2,n-1}$	$c_{n-2,n}$
$X_{n-1}$	$c_{n-1,0}$	$c_{n-1,1}$	...	$c_{n-1,n-2}$	—	$c_{n-1,n}$
$X_n$	$c_{n,0}$	$c_{n,1}$	...	$c_{n,n-2}$	$c_{n,n-1}$	—



Picture 1 – Directed graph

A simplified mathematical model:

$$Z = \sum_{i=0}^n \sum_{j=0}^n c_{ij} \cdot x_{ij} \rightarrow \min \quad (1)$$

Under the following restrictions:

$$\begin{cases} \sum_{i=0}^n x_{ij} = 1, j = \overline{0, n} & (2) \\ \sum_{j=0}^n x_{ij} = 1, i = \overline{0, n} & (3) \\ x_{ij} \geq 0, \quad i = \overline{0, n}; \quad j = \overline{0, n} & (4) \end{cases}$$

Formula (1) is the objective function, which determines the expense on the movement of the bus. It is important that these costs are striving for minimum. Formula (2) is a restriction that the bus visits a bus stop only 1 time. Formula (3) is a restriction that the bus leaves from a bus stop only 1 time. Formula (4) means that the variable  $x_{ij}$  must be positive integer value.

Three groups of constraints are not enough to necessarily make the decision a cycle. Therefore, the solution can include subcycles (cycles that include less than  $n$  bus stops), which is not the proper solution of the task. In connection to this, it is necessary to introduce another restriction.

So, an additional variable should be introduced in order to get a solution in the form of cycle. Additional variable is  $u_i, i = \overline{1, n}$ , which has  $(n-1)^2 - (n-1)$  restrictions:

$$u_i - u_j \leq n - 1; i = \overline{0, n}, j = \overline{0, n} \quad (4)$$

Formula (4) excludes all subcycles and at the same time doesn't exclude any full cycle.

As the bus must pass through each bus stop only once, the selection should be made among the Hamiltonian cycles. Hamiltonian cycle is a cycle that passes through every vertex of the graph exactly once. In order to search for a Hamiltonian cycle with minimum cost, the method of branches and borders must be used.

The idea of the method can be shown by the example of finding the minimum of the function  $f(x)$  on the set of admissible values of the variable  $x$ . This method includes two procedures: branching and finding assessments (the boundary). The procedure of branching is a decomposition of the set of valid values into subsets of the smaller size. The resulting subsets form a tree. The procedure for finding the estimates implies finding upper and lower bounds for solving the problem on a subset of the allowed values of the variable  $x$ .

As an instance, let us find the optimal route for school bus using the method of branches and boundaries. The school bus should set off from school, visit 5 bus stops and come back to school. The matrix of fuel expenses in conventional units (table 2) was filled with real data from the service «Yandex. Cards». The distance between the stops and the school was measured. In addition, the amount of fuel required for moving between points was calculated. The resulting number was multiplied by 100. The task is to find an optimal route, which will minimize fuel consumption for the movement of a school bus.

Let us introduce the following notation:  $x_0$  – the start and end point of the route (school);  $x_1$  – bus stop №1,  $x_2$  – bus stop №2, etc.

In order to solve the task we should use a special system which allows finding the best route by the method of branches and boundaries.

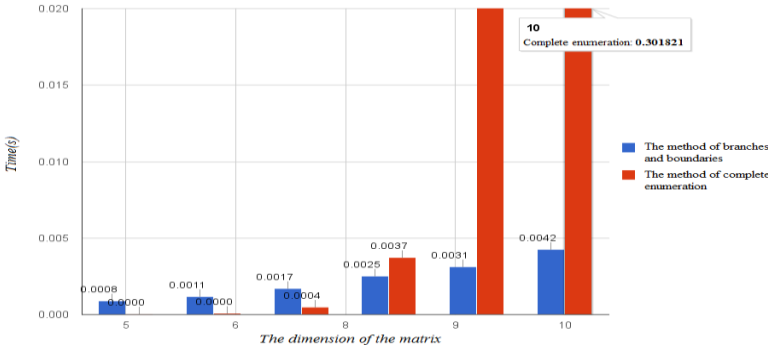
Table 2. Matrix of fuel cost in conventional units

	$x_0$	$x_1$	$x_2$	$x_3$	$x_4$	$x_5$
$x_0$	—	8	8	3	8	3
$x_1$	1	—	1	5	6	8
$x_2$	2	2	—	5	7	8
$x_3$	1	6	5	—	2	4
$x_4$	2	6	6	1	—	4
$x_5$	3	0	8	3	1	—

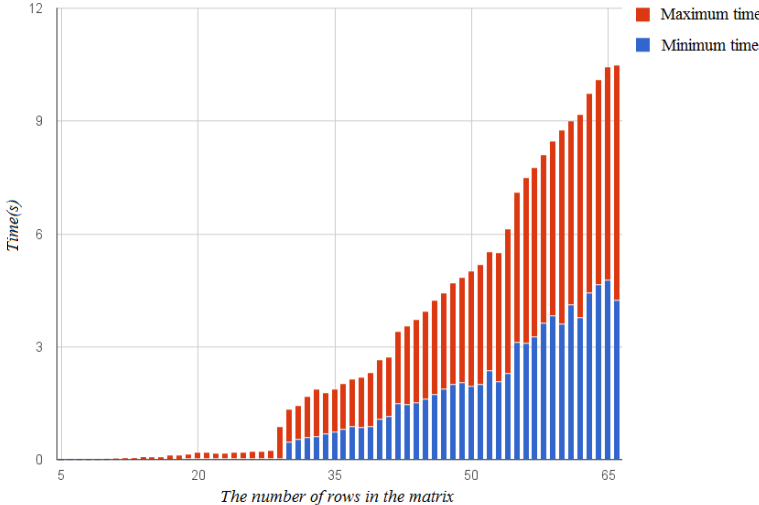
After entering the data into the system, the following path is received: 0–5–4–1–2–3–0 with a total amount of fuel equals to 57 conventional units.

The task can be solved by the method of complete enumeration, but it should be mentioned that the complexity of this method depends on the number of all possible solutions to the task.

If the solution space is very large, a complete enumeration may not give results for several years or centuries. The results of the comparison of method complete enumeration method and branch and bound are shown in the graphs (picture 2,3).



Picture 2 – Graph of dependence of the time on the size of matrix



Picture 3 – Graph of dependence of the maximum and the minimum time for finding solutions on the size of the matrix

The picture 3 shows that the minimum and the maximum times of the solutions increase exponentially [2].

The method of branches and boundaries shows good results for tasks with small dimension. But the task of transport logistics should be solved in a wide way. The task is to find optimal routes for all buses and to optimize the number of buses for schools. It means that one school bus can bring children to several schools that are close to each other. It is also important to organize the routes in such a way that school buses will not be overloaded with children or empty.

The described task belongs to the class of NP-complete tasks. Time needed for algorithm to solve such tasks increases significantly with increasing amount of input data.

Ant [4] and genetic algorithms [5] show good results for solving this kind of tasks.

In future studies it is planned to solve the task using the methods of ant colony or genetic algorithms in order to obtain solutions, close to optimal, in a relatively short time.

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**Аннотация.** В современном мире остро стоит проблема управления транспортными потоками. Ежегодно число транспортных средств в России увеличивается на 1,5 млн, что приводит к перегруженности городских дорог, многочасовым автомобильным пробкам, затруднению движения пешеходов, увеличению количества аварий. В связи с этим необходимо уделять особенное внимание обеспечению безопасности дорожного движения, так как автомобильная дорога является источником повышенной опасности. Одним из составляющих аспектов обеспечения безопасности дорожного движения является вопрос безопасной транспортировки школьников из дома в учебное заведение и наоборот. Для обеспечения безопасности школьников предлагается внедрить программу

«Школьный автобус» в городскую транспортную систему для государственных образовательных учреждений. Статья посвящена исследованию методов поиска оптимальных городских маршрутов для движения школьного автобуса.

**Ключевые слова:** транспортная логистика, школьный автобус, задача коммивояжера, теория графов, метод ветвей и границ.

**Summary.** In today's world, the problem of managing traffic flows is acute. Every year, the number of vehicles in Russia increases by 1.5 million, which leads to the overload of urban roads, hours of traffic jams, obstruction of pedestrian traffic, the increase in the number of accidents. So it becomes necessary to pay close attention to ensuring road safety, since the road is a major source of danger. One of the components of ensuring road safety is the issue of providing safe home-to-school-to-home transport for pupils. To ensure the safety of pupils, it is proposed to introduce the program «School bus» into the urban transport system for state educational institutions. This article concerns the methods of finding optimal urban routes for the movement of a school bus

**Key words:** transport logistics, school bus, traveling salesman problem, graph theory, branch and bound method.

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## **MICROWAVE RESEARCH METHOD OF HEAT-INSULATING PROPERTIES OF COMPOSITE MATERIALS**

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**1. Introduction.** At present, in order to provide energy saving conditions in the construction an additional thermal insulation of fencing building structures and constructions is widely used. Most effectively, this problem is solved by means of using multi-layer (two-and three-layer) structures, in which one layer provides strength and other thermal

protection. When creating and operating such multilayer structures, it is necessary to have information about the thermophysical properties of both separate layers and the entire design of the protective shell as a whole. Therefore, the development and implementation of instruments and measurement systems of nondestructive control of thermophysical properties of layered materials of building structures and products is an urgent task of building thermal technology, which will allow to save the energy resources across the state.

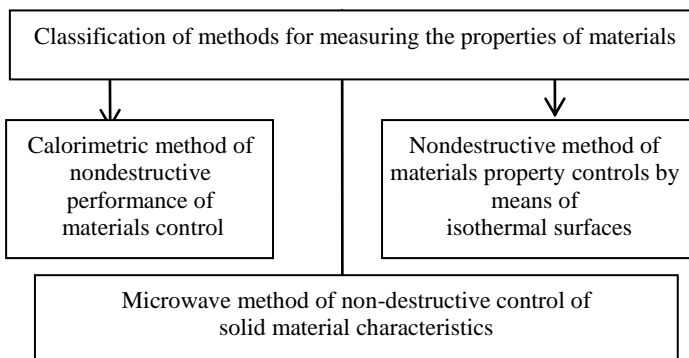
It is known that in order to save fuel and energy resources while the cost of energy has grown acutely currently in accordance with new regulations higher requirements to thermal characteristics of fencing building structures and constructions are imposed. So, for the average area of Russia, the resistance value to heat transfer of enclosing structures of buildings and structures should be increased not less than twice in comparison with the value according of the old normative requirements (Decree of the Ministry of Construction of Russian Federation № 18-81, 11.08.95 about the adoption of change №3 of "Building standards and regulations" II-3-79 "Construction heat engineering"). To ensure these conditions of energy saving in construction there was a need to create and use new building materials with higher values of resistance to heat transfer, i.e. lower coefficients of thermal conductivity and heat transfer.

## **2. The generalized classification of measuring properties methods of materials.**

Nowadays, there are a number of methods and tools to assess the thermal properties of building materials. They differ in labor intensity, productivity, accuracy and cost of measuring instruments. Picture 1 shows a simplified classification of existing methods for determining the thermophysical properties of materials. Consider the main advantages and disadvantages of these methods.

## **3. Calorimetric method of non-destructive control of solid materials characteristics**

The method is based on the determination of the rate of heating or cooling of the test specimen [1, p. 15]. Studies are usually carried out on samples of a simple form on the installation, the scheme of which is shown in the scheme 1. Performance of the calorimeter in the form of a closed container allows to avoid penetration of moisture into the investigated material and is the most convenient under testing materials of powder structure.



Scheme 1 – Generalized classification of existing methods of materials thermophysical properties definitions

Building and heat-insulating materials are often coated with epoxy resin, which also avoids the penetration of moisture into the tested material. The measurement error does not exceed 2...4 % [1, p. 16].

Toward the measuring device 4

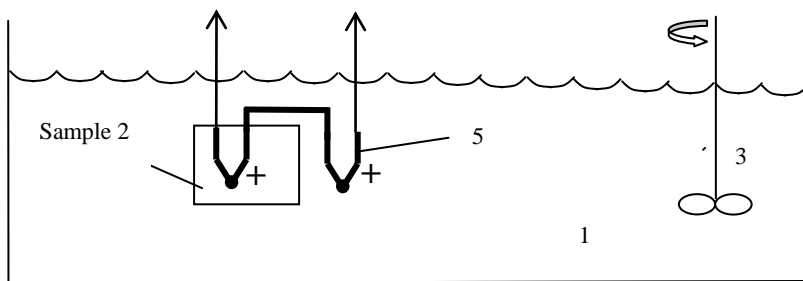


Figure 1 – Structural diagram of the calorimeter of thermal conductivity coefficient of the material

1 – boiling water (when heated) or with melting ice water (while cooling) and ambient temperature  $t_c$ ; 2 – test sample; 3 – stirrer; 4 – measuring device (galvanometer, potentiometer); 5 – differential thermocouple

**Advantages of the method:**

- allows you to determine the absolute value of the temperature coefficient of the material
- provides a sufficiently high accuracy of the experiment;
- relatively short duration of the experiment;
- analytical expressions have a fairly simple form.



The main *disadvantages of the method*:

- experimental conditions require the presence of liquid;
- the experience corresponds to the theory only if the ambient temperature  $t_c$  throughout the experience remains constant;
- to avoid wetting the sample and moisture penetration into the tested material, it is placed in a hermetically sealed glass or its surface is covered with epoxy resin or varnish, which affects the accuracy of measurements;
- while studying the loose material has to be placed in a sealed glass, which reduces the measurement accuracy.

#### 4. Method of nondestructive testing of materials properties by means of isothermal surfaces

The essence of this method consists in the following [1, p. 113]: studied sample in the form of a prism of square section, the length of which many times (6 or more) precedes the width of the face, which provides the condition of infinite length, is placed in the tested cylindrical chamber of the installation, the scheme of which is shown on fig. 2.

The design of the experimental setup consists of two hollow cylinders (1) arranged in each other, serving as isothermal surfaces and made of sheet material. In the gap between the screens, coaxial heaters (2) are installed, powered through the stabilizer from the alternating current network and provide practically symmetrical heating of the test sample in a prism form of square section (3).

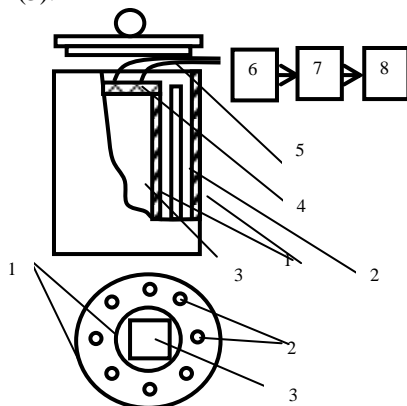


Figure 2 – Scheme of installation for the method isothermal surfaces realization

- 1 – hollow cylinders; 2 – coaxial heaters; 3 – prisms of square crosssection; 4 – hole with cover; 5 – thermocouple; 6 – switch; 7 – amplifier; 8 – computer I/O port.

The analysis of experimental data allows to reveal advantages and disadvantages of the method [1, p. 129]. The heater is equally uniformly placed nichrome wire in coaxial ceramic tubes acting as an electrical insulator. The camera is closed from bottom, and from above there is an aperture with a cover (4) overhand. The sample is placed in installation through this cover. Measurement of temperatures on the edge and in the middle of the edge of the prism is carried out by thermocouples (5), which are connected to the switch (6) and further through the amplifier (7) and the I/O port to the computer (8).

After placing the test sample in the installation chamber, the heaters are switched on and the temperature change is controlled on the edge and in the middle of the prism face. Analysis of experimental data allows to identify the advantages and disadvantages of method [1, p. 129]. Advantages of the method:

- the relative error of measurement of thermal conductivity coefficient, volumetric heat capacity and thermal conductivity of the developed method of nondestructive testing, using the ordered thermal regime in the prism of square crosssection is less than 5 %;
- no need to measure heat transfer coefficients, degree of blackness, heater power;
- no need to account for heat losses due to heat exchange with the environment, as well as contact resistance between the sample and a heater.

The main disadvantages of the method:

- relative complexity of algorithms for processing of measuring information;
- relatively complex design of the installation associated with the exact location of the cylinders regarding each other.

## **5. Microwave method for rapid non-destructive control of thermophysical characteristics of building materials**

The essence of the method consists in the following [1, p. 15]: the sample under study (fig. 4) is performed in the form of a prism of square cross section (parallelepiped) with insulated sides and exposed end faces, through which symmetrical heating of the sample is carried out by the impact of a microwave electromagnetic field from the emitting antennas (1) and (2).

At the same time, the temperature change on the surfaces of the anti-positive faces of the prism is controlled with TC1 and TC2 thermocouples, the temperature is also controlled in the middle of the prism by TP3 thermocouple, and the ambient temperature is controlled by TC4 thermocouple. Thermocouples TC1-TC3 are connected to the processing unit, which implements the processing algorithm in accordance with the

following expressions. Block of automatic power adjustment (APA) under the control of signals from power meters (3, 4), under the action of voltages generated by thermocouples TC1 – TC3, and the signals of the computer (5) sets the power level of the microwave generator (6), providing a sample of a stationary one-dimensional heat flow [2, p. 887].

The temperature control on the end faces, in the middle of the sample is provided and it is achieved at the points indicated temperature  $T_1$ ,  $T_2$ ,  $T_3$ . The power meters (3, 4) have mobile capacitive probes and allow to control reflected and falling on the material power, which allows to take into account in the calculations reflected from the sample electromagnetic energy by means of processing unit (7) [2, c. 887].

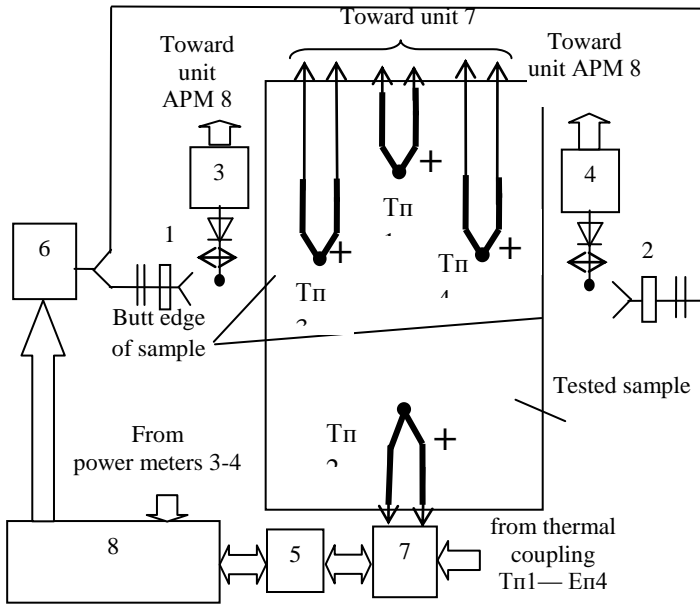


Figure 3 – Scheme of installation for implementing the method of microwave

Unit 8 of automatic power control (APC) provides a given power level on antennas 1, 2. Thus, there is a thermal balance between the amount of heat released in the sample under the influence of microwave radiation and the amount of heat discharged into the environment through the free (non-insulated) end faces of the prism. For the steady-state values of

temperatures in the controlled points in the  $i$  and  $j$  points of time the conditions are following [1, p. 139]:

$$\Delta T_i = T(\tau_{i+1}) - T(\tau_i) \leq \varepsilon \quad \text{for } T_{\text{ycr1}}(T_{\text{ycr2}}); \quad (2.1)$$

$$\Delta T_j = T(\tau_{j+1}) - T(\tau_j) \leq \varepsilon \quad \text{for } T_{\text{ycr1}}(T_{\text{ycr2}}), \quad (2.2)$$

where  $\varepsilon = 0,01$  °C.

Measured by thermocouples TC1-TC3, the values of the steady-state temperature are placed into the microprocessor. The ambient temperature is measured using a thermocouple TC4, the power of the microwave generator (6) is also determined, at which a stationary heat flux is set in the sample under study, and the information obtained is recorded in the memory of the microprocessor. Since when the sample is heated, a part of the energy of microwave radiation is reflected from the surfaces of the prism end faces, then with the help of power meters (3) and (4) placed at antennas (1) and (2), the energy power of the reflected radiation is measured and the information obtained is used to form measuring information about the material under study.

Building materials are complex dielectric heterogeneous media with capillary-porous structure. In the dry state, they are inhomogeneous dielectricians, and in the wet one they are semiconductor media. In real natural conditions, these environments are constantly in contact with the changing temperature field and water in its various aggregate states. Water is a variable component and determines the dielectric properties of such media. In general, when exposed to microwave radiation, building materials are heated unevenly over the entire sample volume, the temperature of areas with a higher water content increases faster.

To simplify finding the required dependencies, one must perform the following assumptions:

- in the effective area of opening the horn emitter generates a level electromagnetic wave;

- heated sample consists of a homogeneous material with uniform moisture distribution in volume.

In this case, ignoring the influence of drying equation for the distribution of temperature in a homogeneous material, irradiated by a level electromagnetic wave with its normal incidence on the half-space, has the form [1, p. 140]

$$\frac{\partial T}{\partial \tau} = a_r \frac{\partial^2 T}{\partial x^2} + \frac{P(x)}{c\rho}, \quad (2.3)$$

where  $T$  is the local temperature of the sample from the surface into the material;  $x$  — coordinate;  $a_r$  is the thermal diffusivity of the sample material;  $C$  — heat capacity material  $La$  of the sample;  $\rho$  — the density of the sample material;  $\tau$  is the exposure time of the sample

The boundary conditions for this equation are

$$T = T_0 \quad \text{when } \tau = 0; \quad (2.4)$$

$$\lambda \frac{\partial T}{\partial x} \Big|_{x=0} = \alpha (T \Big|_{x=0} - T_4), \quad (2.5)$$

where  $\lambda$  – the conductivity of the sample material;  $\alpha$  — heat transfer coefficient;  $T_4$  - ambient temperature.

As a result of the unilateral thermal effect of the electromagnetic wave on the sample, the specific power of the energy emitted in it in accordance with the ratio will be determined

$$p_1(x) = 2\beta p_x (1 - \gamma) \exp(-2\beta_x x) \quad (2.6)$$

where  $x$  — coordinate in the interior of the sample;  $\beta$  — the attenuation coefficient of electromagnetic wave;

$\gamma$  — electromagnetic wave reflection coefficient;  $p_x$  — flux density of microwave energy falling on the sample, during which there is a heat balance.

The intensity of attenuation and reflection of the EM wave depends on the moisture content of the sample material, which is resulted from the connection of these processes with the dielectric properties of the material. This relationship is defined by the following relations [1, p. 140]:

$$\alpha = \frac{2\pi}{\lambda_r} \sqrt{\frac{\varepsilon'_{cm} \mu}{2} (\sqrt{1 + \text{tg}^2 \delta} - 1)}; \quad (2.7)$$

$$\gamma = \frac{(1 - \sqrt{\varepsilon' - j\varepsilon''})^2}{(1 - \sqrt{\varepsilon' + j\varepsilon''})^2}, \quad (2.8)$$

where  $\varepsilon'$  and  $\varepsilon''$  – accordingly, the actual and complex components of dielectric conductivity;  $\text{tg} \delta = \frac{\varepsilon'}{\varepsilon''}$  – tangent of angle of dielectric loss;  $\mu$  – magnetic conductivity;  $\lambda_r$  – EM wave length.

For all materials, dielectric permeability is a function of moisture, temperature, chemical composition, structural features and other factors.

Dependence of dielectric properties of the material on moisture is explained by one of the unique properties of water — abnormally high dielectric constant. This feature, causing by laws of quantum mechanics, leads to the fact that even in the absence of an external electric field of the water molecule has its own dipole moment. In the process of electromagnetic field influence on water the orientation of polar molecules takes place. The rotation of the molecules lags from the torque caused by a variable electromagnetic field, due to forces of friction, which reduces also the amplitude of the resulting polarization. This decrease is characterized by

a relaxation time. With symmetrical heating of the two opposite faces of the prism thickness  $H$ , the total specific power of the energy released in the sample in accordance with data [1, p. 141] and formula (2.6) will be equal

$$p_2(x) = 2\beta p_x(1 - \gamma)\exp(-2\beta x) + 2\beta p_x(1 - \gamma)\exp(-2\beta(H - x)). \quad (2.9)$$

The amount of heat absorbed by the sample per unit time is determined by the ratio

$$Q_x = \int_0^H p_2(x) dx. \quad (2.10)$$

The absorbed heat causes the sample to heat and partially dissipates to the surrounding medium during heat transfer through the insulation-free faces, resulting in a one-dimensional heat flux density from the middle of the prism to the faces in the direction of the normal to these faces

$$q = \frac{Q}{S_2},$$

where  $S_2 = 2S_1$  — the total square of the free sides;  $S_1$  — square of one side.

Varying by the power of electromagnetic microwave radiation, it is possible to determine such a thermal (energy) mode in which the heat released in the sample is completely generated in the heat exchange with the environment and does not lead to further heating of the sample, i.e. in the studied sample a stationary heat flow is established.

In the mode of steady-state heat flow, the heat transfer coefficient of the studied material in accordance with [1, c. 142] is determined by the equation.

$$\alpha = \frac{Q_x}{S_2 \Delta T_1} = \frac{Q_x}{S_2 (T_{cp} - T_4)}, \quad (2.11)$$

where  $Q_x$  — amount of heat passed through the surface with square  $S_2$ ;

$\Delta T_1$  — difference among temperature of surrounding environment  $T_4$  and average temperature of surface of lateral sides  $T_{cp}$ , determined as

$$T_{cp} = (T_1 + T_2) / 2.$$

Since a part of the microwave radiation is reflected from the surface of the side when the image is heated and these  $Q$  losses are fixed by microwave wattmeters, it is advisable to use the following formula to obtain a more accurate measurement of the heat transfer coefficient of the test sample:

$$\alpha = \frac{Q_x - Q_{\text{пот}}}{S_2 \Delta T_1}, \quad (2.12)$$

where the pot  $Q$  — the total energy of microwave radiation reflected from the surfaces of the lateral sides, defined as  $Q_{\text{not}} = Q_{\text{not}}^1 + Q_{\text{not}}^2$ ;  $Q_{\text{not}}^1$  — losses from the first non-isolated side;  $Q_{\text{not}}^2$  losses from the second non-insulated side.

Averaging of the temperature value in the formula (2.12) allows to reduce the share of the total error of the required thermophysical characterization.

The required coefficient of thermal conductivity of the researched material under such thermal conditions and experimental ones in accordance with [1, c. 142] is determined from the equation.

$$\lambda = -\frac{q}{\text{grad } T}, \quad (2.13)$$

where  $\text{grad } T$  — temperature gradient in the sample under study, i.e. temperature change per unit length in the direction of heat flow in the sample.

In this case  $\text{grad } T = \Delta T / h$ , where  $\Delta T = T_3 - T_{\text{cp}}$  — a difference between the temperature in the middle section of the sample (where the heat flux begins) and the average temperature of the surfaces of the end sides through which the heat transfer occurs;  $h$  — the distance between the free surface of the prism side and its middle section (middle).

### Conclusion

Calorimetric method for measuring the coefficient of thermal conductivity of the material with its ease of implementation has a number of significant drawbacks that prevent its wide implementation.

The method of isothermal surfaces eliminates the need to measure such physical quantities as the heat transfer coefficient, the degree of blackness of the heater power and does not require taking into account heat losses due to heat exchange with the environment, as well as the contact resistance between the sample and the heater, which is its unconventional advantage. However, the relative complexity of the design and algorithms of measurement data processing its wide application.

Microwave method of operative nondestructive control of thermophysical characteristics of building materials provides heating of the sample with energy of microwave radiation and allows to reduce experiment time by an order in comparison with known methods and means of the given appointment. In addition, the developed method allows to improve the accuracy of measurement results by eliminating the influence of the state of the top of the test samples (roughness, degree of blackness) and thermal losses from the top of the test sample. Taking into account the

electromagnetic wave reflections from the studied material with the help of mobile capacitive probes of power meters significantly reduces the resulting measurement error. Thus, the comparative analysis of the three methods suggests that the microwave method of research of building materials is the most perceptive one.

The objective of further research is to improve the research methodology, simplify the design of the ultra-high-frequency part of the installation and improve the accuracy, level of automation and measurement performance.

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**Аннотация.** Анализ калориметрического метода измерения коэффициента температуропроводности материала показывает, что имеет ряд существенных недостатков, препятствующих его широкому внедрению.

Метод изотермических поверхностей позволяет исключить необходимость в измерении коэффициента теплообмена. Однако относительная сложность конструкции и алгоритмов обработки измерительной информации сдерживает его широкое применение.

Микроволновый метод контроля характеристик материалов обеспечивает быстрый нагрев образца энергией СВЧ-излучения и позволяет на порядок уменьшить время эксперимента по сравнению с известными методами и средствами данного назначения.

**Ключевые слова:** неразрушающий контроль; калориметрический измеритель; изотермические поверхности; микроволновый метод; термопара; автоматическая регулировка мощности; СВЧ-излучения; СВЧ-ваттметр.

**Summary.** Analysis of the calorimetric method for measuring the temperature coefficient of the material shows that it has a number of significant disadvantages that prevent its wide implementation.



The method of isothermal surfaces eliminates the need to measure the heat transfer coefficient. However, the relative complexity of the design and the processing of measurement data hinder its wide application.

A microwave method of controlling the characteristics of materials ensures rapid heating of the sample by the energy of the microwave radiation and allows an order to reduce the time of the experiment in comparison with the known methods and means of appointment.

**Keywords:** non-destructive testing; calorimetric meter; ISO-thermal surfaces; microwave method; thermocouple; automatic power control; microwave radiation; microwave wattmeter.

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## ALGORITHM FOR UNIFICATION OF MEDICAL DATA

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An integral part in the correct diagnosis and further treatment is the collection of reliable information from the object of study. At the moment, there are many technical solutions aimed at the study of various organs and groups of human organs. The actual problem in the study is the task of unification of the obtained data, with the aim of possible manipulation of the results. This problem has arisen as a result of the fact that there are medical electronic devices built on different technologies and using different software [4][30]. This is especially true of devices manufactured in the 90s, as manufacturers of electronic equipment did not adhere to the uniform rules of development. Therefore, a single standard is needed, which will include all aspects of data processing. This standard is Digital Imaging and Communications in Medicine (DICOM). DICOM is the industry standard for manipulating medical images and documents. The standard was developed By the national Association of manufacturers of electronic equipment (NEMA), which took as its basis the standard Open system Interconnection (OSI), which was created by the international Standards Organization (ISO).

The DICOM standard contains two information layers:

- file level-an object-oriented file that has a tagged organization to represent an image frame and accompanying or controlling information;
- network layer-a Protocol for transferring DICOM files and DICOM control commands over networks that support a set of TCP/IP network protocols.

The file level contains information about the patient, equipment, date and time, personnel who participated in the study. It also contains an image obtained as a result of the study. This structure allows manufacturers of electronic equipment to follow a single solution, through which it is possible to combine medical equipment from different manufacturers into a single clinical information system for further analysis of the results of the study. This possibility not only facilitates the work of staff using computer technology, but also profitable from an economic point of view.

The DICOM network Protocol describes how to transfer medical information from medical equipment to Picture Archiving and Communication system. The system involves the creation of special archives with research results on DICOM servers, necessary for a quick search and view the information of interest. This allows you to create a single DICOM network through which data can be exchanged.

The aim of this work is to develop an algorithm and software module that allows to convert the data obtained from the study to a single DICOM standard. This solution allows not only to unite electronic equipment into one group, but also to create a single information network, within the framework of which, the exchange of information between medical units and institutions is possible.

The input data for this module is the image coming from the medical electronic equipment, as well as related information entered by the doctor during the study. The output of the module is a document in the format DICOM 3.0. In accordance with the requirements of the DICOM standard, the software module consists of the following blocks:

1. Equipment type selection unit
2. Research data acquisition unit
3. The unit of analysis and data preparation
4. Block the formation of a DICOM document
5. The unit of analysis of adequacy of the received model

The function of the equipment type selection unit is to form a menu with a list of existing equipment used in the study, from which the doctor selects the equipment needed at the moment. This will allow you to configure the software module to work with the selected equipment. In the DICOM standard stipulates the presence of concomitant information such

as time of survey, name of patient, name of doctor, name of the organ under investigation, etc. For metadata entry meets the block of information gathering. The block allows you to enter metadata by means of a graphical interface in accordance with the DICOM standard. The entered information is stored in temporary memory and will be used further. The data analysis and preparation unit is designed to transform the data obtained during the study. First, the text information is compressed by means of the RLE method. The image or series of images is then compressed using the JPEG algorithm. The use of these algorithms can significantly reduce the amount of disk space occupied without significant loss of information quality. The next step is to generate a document in DICOM 3.0 format ( \* .dcm). The doctor specifies the name of the document himself, but for backward compatibility with older software, it is recommended to use no more than 8 characters without spaces. The document is stored in temporary memory for further verification. After you generate and save the DICOM document, you need to check the resulting model. The doctor analyzes the result, and he can correct mistakes or conduct a study again. The result is presented in the form of a final report, with the possibility of full editing of information. If the doctor confirms the results of the study, DICOM document is stored in permanent memory. The number of documents will be equal to the number of frames taken during the study. Also, the DICOMDIR file is saved-it is a specialized DICOM file that serves to catalog information, and contains service information for all DICOM files located on this storage device.

In this form, the software module requires the participation of a physician conducting research to obtain related information. For example, it is needed for selecting the type of electronic equipment or the frequency of radiation. Therefore, the further development of this algorithm will be the automation and three-dimensional visualization of the research process, which will avoid errors during the study and demonstrate the results.

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**Аннотация.** В данной статье была рассмотрена проблема унификации данных, полученных в ходе исследования пациента. Предложен способ, по которому осуществляется совмещение всех типов электронного оборудования в одну информационную структуру.

**Ключевые слова:** DICOM, обработка данных, технический прогресс, алгоритм, стандарт, исследование.

**Summary.** In this article the problem of unification of the data obtained in the course of the patient's study was considered. The method by which all types of electronic equipment are combined into one information structure is proposed.

**Key words:** DICOM, data processing, technical progress, the algorithm, standard, study.

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## MEASURING CONVERTER ON THE BASIS OF BIDIRECTIONAL COUPLER

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### 1. Introduction.

Famous measuring transducers of reflectometric type have a number of disadvantages, which prevent to increase the accuracy of reflection coefficient measurement of different two-poles, for example, antennas for radar stations and other microwave radio systems. directional couplers reflectometers have a non-sufficient orientation, which leads to an unacceptable increase in error in the measurement of small values of the reflection coefficient module. With the increase in the operating frequency of the microwave generator, the specified error component increases significantly, due to the insufficient directivity of the couplers. It is not

possible to increase the orientation of the multi-line coupler by technological methods at the present time, therefore, further increase in accuracy is provided by structural methods of correction of measurement error. Meters based on the symmetric bidirectional coupler are of interest because of the requirements for the directivity of such twelve pole significantly reduced. At the same time, the cost of production of these elements is significantly lower compared to conventional directional couplers. It is appropriate to explore the potential of such beneficiaries.

## 2. Investigation of the properties of a symmetric twelve pole on the basis of a bidirectional coupler

It is known that if a twelve-pole has a geometric symmetry, does not contain anisotropic elements and has negligible losses, then a theoretical analysis of its properties is possible. Twelve-pole, used in the scheme in fig. 2.1 has an air-filled, has a geometric symmetry, therefore, can be classified as such multipole. It can be seen as a combination of two symmetrically coupled directed branches.

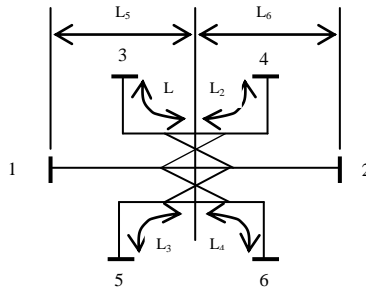


Fig. 2.1 — Electrical schematic diagram of symmetrical twelve-pole

The scattering matrix of the twelve-pole can be written as follows [1, 2]

$$(2.1) \quad \begin{bmatrix} S \\ \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} & S_{13} & S_{14} & S_{15} & S_{16} \\ S_{21} & S_{22} & S_{23} & S_{24} & S_{25} & S_{26} \\ S_{31} & S_{32} & S_{33} & S_{34} & S_{35} & S_{36} \\ S_{41} & S_{42} & S_{43} & S_{44} & S_{45} & S_{46} \\ S_{51} & S_{52} & S_{53} & S_{54} & S_{55} & S_{56} \\ S_{61} & S_{62} & S_{63} & S_{64} & S_{65} & S_{66} \end{bmatrix},$$

where  $S_{ij}$ ,  $S_{ji}$  — complex coefficients of transmission and reflection of the twelve-pole.

Since the twelve-pole does not contain anisotropic elements, in accordance with the principle of reciprocity

$$(2.2)$$

$$S_{12} = S_{21}, S_{16} = S_{61}, S_{35} = S_{53}, S_{34} = S_{43}, S_{13} = S_{31}, S_{24} = S_{42}, S_{36} = S_{63}, S_{56} = S_{65}, S_{14} = S_{41}, S_{25} = S_{52}, S_{45} = S_{54}, S_{23} = S_{32}, S_{15} = S_{51}, S_{26} = S_{62}, S_{46} = S_{64}.$$

In consideration (2.2) expression (2.1) can be written in such manner

$$\begin{bmatrix} S \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} & S_{13} & S_{14} & S_{15} & S_{16} \\ S_{12} & S_{22} & S_{23} & S_{24} & S_{25} & S_{26} \\ S_{13} & S_{23} & S_{33} & S_{34} & S_{35} & S_{36} \\ S_{14} & S_{24} & S_{34} & S_{44} & S_{45} & S_{46} \\ S_{15} & S_{25} & S_{35} & S_{45} & S_{55} & S_{56} \\ S_{16} & S_{26} & S_{36} & S_{46} & S_{56} & S_{66} \end{bmatrix}.$$

Then the condition of the unitarity of the matrix is written in expanded form as a system of equations [2]:

$$(2.3)$$

$$\begin{aligned} S_{11}^2 + S_{12}^2 + S_{13}^2 + S_{14}^2 + S_{15}^2 + S_{16}^2 &= 1; \\ S_{21}^2 + S_{22}^2 + S_{23}^2 + S_{24}^2 + S_{25}^2 + S_{26}^2 &= 1; \\ S_{31}^2 + S_{32}^2 + S_{33}^2 + S_{34}^2 + S_{35}^2 + S_{36}^2 &= 1; \\ S_{41}^2 + S_{42}^2 + S_{43}^2 + S_{44}^2 + S_{45}^2 + S_{46}^2 &= 1; \\ S_{51}^2 + S_{52}^2 + S_{53}^2 + S_{54}^2 + S_{55}^2 + S_{56}^2 &= 1; \\ S_{61}^2 + S_{62}^2 + S_{63}^2 + S_{64}^2 + S_{65}^2 + S_{66}^2 &= 1; \\ S_{11} S_{21}^* + S_{21} S_{22}^* + S_{31} S_{41}^* + S_{41} S_{43}^* + S_{51} S_{53}^* + S_{61} S_{51}^* &= 0; \\ S_{11} S_{31}^* + S_{21} S_{41}^* + S_{31} S_{33}^* + S_{41} S_{43}^* + S_{51} S_{55}^* + S_{61} S_{43}^* &= 0; \\ S_{11} S_{41}^* + S_{21} S_{31}^* + S_{31} S_{43}^* + S_{41} S_{44}^* + S_{51} S_{63}^* + S_{61} S_{53}^* &= 0; \\ S_{11} S_{51}^* + S_{21} S_{61}^* + S_{31} S_{53}^* + S_{41} S_{63}^* + S_{51} S_{65}^* + S_{61} S_{65}^* &= 0; \\ S_{11} S_{61}^* + S_{21} S_{51}^* + S_{31} S_{63}^* + S_{41} S_{53}^* + S_{51} S_{53}^* + S_{61} S_{51}^* &= 0; \\ S_{21} S_{31}^* + S_{22} S_{41}^* + S_{41} S_{33}^* + S_{31} S_{44}^* + S_{61} S_{53}^* + S_{51} S_{63}^* &= 0; \\ S_{21} S_{41}^* + S_{22} S_{31}^* + S_{41} S_{43}^* + S_{31} S_{44}^* + S_{61} S_{63}^* + S_{51} S_{53}^* &= 0; \\ S_{21} S_{51}^* + S_{22} S_{61}^* + S_{41} S_{53}^* + S_{21} S_{63}^* + S_{53} S_{63}^* + S_{55} S_{63}^* &= 0; \\ S_{21} S_{61}^* + S_{22} S_{51}^* + S_{41} S_{63}^* + S_{31} S_{53}^* + S_{61} S_{65}^* + S_{51} S_{66}^* &= 0; \\ S_{31} S_{34}^* + S_{41} S_{31}^* + S_{33} S_{43}^* + S_{43} S_{44}^* + S_{53} S_{63}^* + S_{63} S_{53}^* &= 0; \\ S_{31} S_{51}^* + S_{41} S_{61}^* + S_{33} S_{53}^* + S_{33} S_{64}^* + S_{53} S_{65}^* + S_{63} S_{65}^* &= 0; \\ S_{31} S_{61}^* + S_{41} S_{51}^* + S_{33} S_{63}^* + S_{43} S_{53}^* + S_{53} S_{65}^* + S_{63} S_{66}^* &= 0; \\ S_{41} S_{51}^* + S_{31} S_{61}^* + S_{43} S_{53}^* + S_{44} S_{63}^* + S_{63} S_{55}^* + S_{53} S_{65}^* &= 0; \\ S_{41} S_{61}^* + S_{31} S_{51}^* + S_{43} S_{63}^* + S_{44} S_{53}^* + S_{63} S_{65}^* + S_{53} S_{66}^* &= 0; \\ S_{51} S_{61}^* + S_{61} S_{51}^* + S_{53} S_{63}^* + S_{63} S_{53}^* + S_{55} S_{65}^* + S_{65} S_{66}^* &= 0. \end{aligned}$$

Let say that twelve pole has a perfect orientation and symmetry on the vertical and horizontal axes:

$$L_1=L_2=L_3=L_4=L_5=L_6; S_{41}=S_{61}=S_{32}=S_{52}; S_{31}=S_{51}=S_{35}=S_{42}=S_{62}=S_{64}=0; \quad (2.4)$$

$$S_{34}=S_{65}$$

Taking into consideration (2.4), we write:

$$S_{21}=S_{21}e^{j2\alpha L}; S_{34}=S_{34}e^{j2\alpha L};$$

$$S_{41}=S_{41}e^{j(2\alpha L+\varphi_{41})},$$

$$S_{51}=S_{51}e^{j(2\alpha L+\varphi_{51})}.$$

Then from (2.3) we'll get:

$$S_{21}^2+2S_{41}^2=1;$$

$$S_{41}^2+S_{34}^2+S_{36}^2=1;$$

$$S_{21}S_{41}^*+S_{41}S_{43}^*+S_{41}S_{36}^*=0;$$

$$S_{41}S_{41}^*+S_{34}S_{36}^*+S_{36}S_{34}^*=0.$$

Where, after a simple transformation, we will find:

$$\varphi_{36}=\arccos \frac{S_{41}^2}{2S_{43}S_{36}} \quad (2.5)$$

$$\varphi_{41}=\arctg \sqrt{\frac{(S_{34}+S_{21})^2-S_{36}^2}{(S_{34}-S_{21})^2-S_{36}^2}} \quad (2.6)$$

$$S_{21}=\sqrt{1-\frac{2}{c}} \quad (2.7)$$

$$S_{41}=\frac{1}{\sqrt{c}} \quad (2.8)$$

$$S_{63}=1/c \quad (2.9)$$

$$S_{43}=\sqrt{1+\frac{1}{c}} \quad (2.10)$$

where  $c$  and  $d$  – the transitional weakening and direction of couplers of twelve pole.

The analysis of expressions (2.5)—(2.10) shows that an ideal symmetric twelve-pole with two combined directional couplers is physically feasible under the condition

$$(S_{41}^2/(2S_{43} S_{36})) \leq 1.$$

There we'll get  $c \geq 2$ .

The calculation shows that if one connect a microwave generator to shift 1, when  $c = 2$  the electromagnetic wave in the shift 2 does not pass and it is distributed equally between the shifts 4, 6. When  $c = 3$ , it is divided between the shifts 2, 4, 6 into three equal parts. Dependencies calculated by formulas (2.5) – (2.10) are shown in Fig. 2.1-2.3. As follows from the drawings, when reaching the transition to the weakening of the channels of twelve pole 15 dB or more, the phase shifts of transmission of S36, S41 close to the values  $120^\circ$  and  $90^\circ$  respectively.

Let us now consider the real case when a twelve-pole has a finite directivity and some asymmetry of the channels modulo the transfer coefficients. That is:

$$S_{41} \neq S_{61}; \quad S_{32} \neq S_{52}; \quad S_{31} \neq S_{51}; \quad S_{42} \neq S_{62}.$$

In addition, in practice there is always  $S_{ii} \neq 0$ .

Taking into account the above we write:

$$(2.11)$$

$$\begin{aligned} S_{21} &= S_{21} \cdot e^{j2\alpha L}; \\ S_{32} &= S_{41} = S_{41} \cdot e^{j(2\alpha L + \varphi_{41})}; \\ S_{51} &= S_{62} = S_{51} \cdot e^{j(2\alpha L + \varphi_{51})}; \\ S_{51} &= S_{61} = S_{61} \cdot e^{j(2\alpha L + \varphi_{61})}; \\ S_{31} &= S_{42} = S_{42} \cdot e^{j(2\alpha L + \varphi_{32})}; \\ S_{34} &= S_{34} \cdot e^{j2\alpha L}; \\ S_{56} &= S_{56} \cdot e^{j2\alpha L}; \\ S_{54} &= S_{63} = S_{63} \cdot e^{j(2\alpha L + \varphi_{63})}; \\ S_{54} &= S_{63} = S_{63} \cdot e^{j(2\alpha L + \varphi_{63})}; \\ S_{35} &= S_{46} = S_{46} \cdot e^{j(2\alpha L + \varphi_{46})} \end{aligned}$$

Then from (2.3), (2.11) we'll get:

$\varphi_{41} = \arctg \sqrt{-\frac{[S_{41}(S_{34} + S_{21}) + \Delta_{41}]^2 - S_{61}^2 S_{36}^2}{S_{41}^2 (S_{34} - S_{21})^2 - S_{61}^2 S_{36}^2}}$	(2.12)
$\varphi_{31} = \arctg \sqrt{-\frac{[S_{31}(S_{34} + S_{21}) + \Delta_{31}]^2 - S_{61}^2 S_{53}^2}{S_{31}^2 (S_{34} - S_{21})^2 - S_{61}^2 S_{53}^2}}$	(2.13)
$\varphi_{61} = \arctg \sqrt{-\frac{[S_{61}(S_{56} + S_{21}) + \Delta_{61}]^2 - S_{41}^2 S_{36}^2}{S_{61}^2 (S_{56} - S_{21})^2 - S_{41}^2 S_{36}^2}}$	(2.14)



$\varphi_{51} = \arctg \sqrt{-\frac{[S_{51}(S_{56} + S_{21}) + \Delta_{51}]^2 - S_{41}^2 S_{53}^2}{S_{51}^2 (S_{56} - S_{21})^2 - S_{41}^2 S_{53}^2}}$	(2.15)
$S_{21} = \sqrt{1 - \frac{1}{c_1} - \frac{1}{c_2} - \frac{1}{c_1 d_1} - \frac{1}{c_2 d_2}}$	(2.16)
$S_{41} = \frac{1}{\sqrt{c_1}}$	(2.17)
$S_{31} = \frac{1}{\sqrt{c_1 d_2}}$	(2.18)
$S_{63} = \sqrt{c_1 c_2}$	(2.19)
$S_{53} = \sqrt{\frac{1}{c_1 c_2 d_2}}$	(2.20)
$S_{43} = \sqrt{1 - \frac{1}{c_1} - \frac{1}{c_1 d_1} - \frac{1}{c_2 c_2} - \frac{1}{c_1 c_2 d_2}}$	(2.21)
$S_{61} = \sqrt{\frac{1}{c_2}}$	(2.22)
$S_{51} = \sqrt{\frac{1}{c_2 d_2}}$	(2.23)

where  $\Delta_{31} = (S_{11} + S_{44})S_{41} + S_{51}S_{63}$ ;  $\Delta_{41} = (S_{11} + S_{33})S_{31} + S_{51}S_{53}$ ;

$S_{51} = (S_{11} + S_{66})S_{61} + S_{31}S_{63}$ ;  $S_{61} = (S_{11} + S_{55})S_{51} + S_{31}S_{53}$ ;

$c_1, d_1$  — transient attenuation and direction of the branch of the incident wave, respectively;

$c_2, d_2$  — transient attenuation and directivity of the channel branch of the reflected wave, respectively;

$S_{ii}$  — reflection coefficients from the inputs of the quadrupole.

When entering the symbols in this work, one can write

$$\Delta_n = \varphi_{41} - \varphi_{42},$$

where  $\Delta_{41}, \Delta_{42}$  — differential phase shifts of transmission coefficients  $S_{41}, S_{42}, S_{52}, S_{51}$ .

It is obvious that the function

$$(2.24)$$

$$\Delta_\varphi = \Delta_n - \Delta_0$$

characterizes the degree of phase asymmetry of the twelve-pole.

Calculations on formula (2.23) are presented in Fig. 2.3. It is clear that when  $c_1 \geq 15$  дБ,  $c_2 \geq 15$  дБ,  $\Delta c = 2$  дБ,  $\Delta d = 2$  дБ phase asymmetry of the twelve-pole does not exceed tenths of a degree.

We estimate the error due to phase asymmetry of the twelve-pole. To do this, rewrite the expression (1.8), (1.9) in the form of:

$$U_{\Pi} = KE^2 \frac{1}{c} \left\{ 1 + \Gamma_x^2 \frac{1}{d} + \frac{2\Gamma_x}{\sqrt{d}} \cos(\psi_x + 2\alpha L_2 + \Delta\varphi) \right\} \quad (2.25)$$

$$U_0 = K \cdot E^2 \cdot 1/c \cdot [1/d + \Gamma_x^2 + \frac{2\Gamma_x}{\sqrt{d}} \cos[\psi_x + 2\alpha L_2]] \quad (2.26)$$

From (1.15) taking into account (2.25), (2.26) we'll get

$$U_{PV} = K_{PV} \sqrt{\Gamma_x^2 + \frac{2\Gamma_x}{\sqrt{d}} [\cos(\psi_x + 2\alpha L_2 + \Delta\varphi) - \cos(\psi_x + 2\alpha L_2)]}.$$

Then for the relative error of measurement of  $\Gamma_x$  can be written

$$\delta = \sqrt{1 + \frac{2}{\Gamma_x \sqrt{d}} [\cos(\psi_x + 2\alpha L_2 + \Delta\varphi) - \cos(\psi_x + 2\alpha L_2)]} \quad (2.27)$$

Calculations by the formula (2.27) show that the limiting measurement error due to phase asymmetry of the twelve-pole when  $\Gamma_x = 0,1$ ,  $\Delta\varphi = 0,2^\circ$ ,  $d = 20$  дБ doesn't exceed 0,4%, and this indicates the possibility of its use in the reflectance meters in the millimeter wave range.

Рис. 2.1 — Зависимости фазовых сдвигов  $\varphi_{36}$  и  $\varphi_{41}$  от переходного ослабления каналов ответвителя

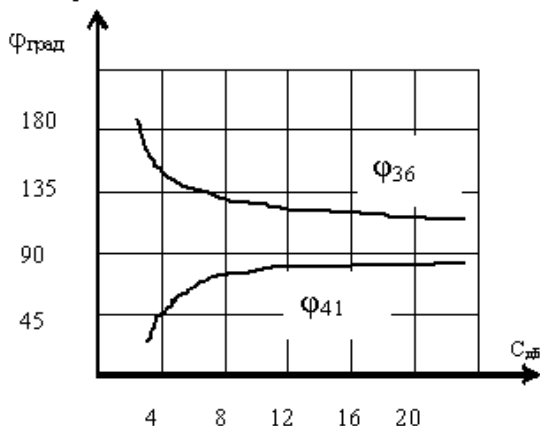


Рис. 2.2 — Зависимости модулей коэф фициентов передачи  $S_{21}$ ,  $S_{41}$  и  $S_{43}$  двенадцатиполосника от переходного ослабления каналов ответвителя

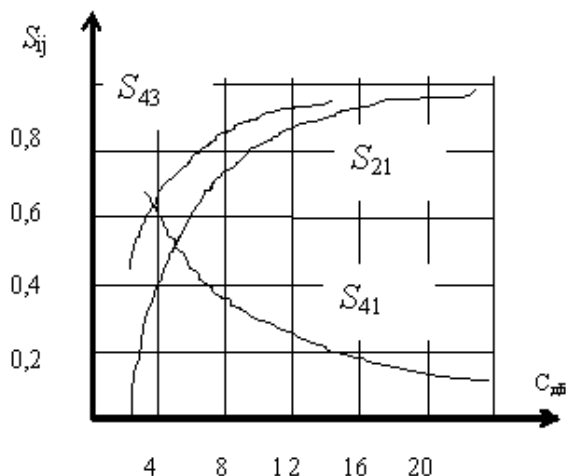
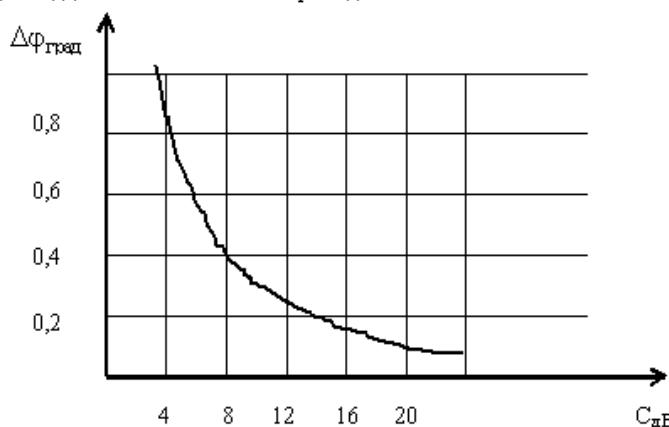
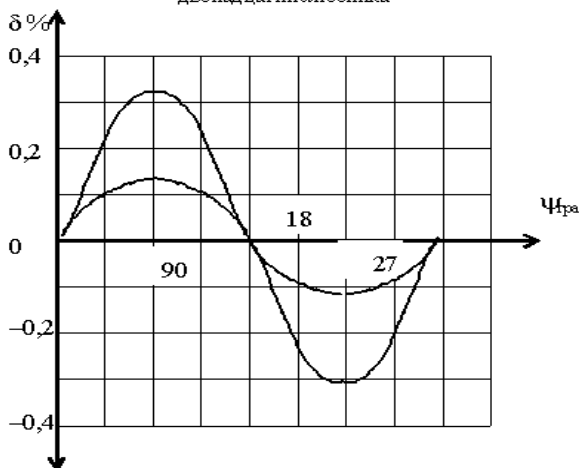


Рис. 2.3 — Зависимости неидентичности фазовых сдвигов каналов двенадцатиполосника от переходного ослабления его ответвителей



The results of calculation according to the formula are shown on the picture 2.4 (2.27)

Рис. 2.4 — Предельная относительная погрешность измерения модуля коэффициента отражения за счет фазовой асимметрии двенадцатиполосника



**Conclusion.** Thus, a symmetrical twelve-pole based on a bidirectional coupler has a satisfactory identity of the amplitude-frequency and phase-frequency characteristics of the reference and measuring channels and can be used in microwave-range reflectometric schemes in the measurement of the reflectivity of multi-poles of the millimeter wave range.

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**Аннотация.** Направленные ответвители рефлектометров имеют недостаточную направленность, что приводит к снижению точности измерения при уменьшении модуля коэффициента отражения. С повышением рабочей частоты СВЧ генератора указанная составляющая погрешности так же заметно увеличивается. Повысить направленность обычного многодырочного ответвителя технологическими методами уже не удастся, поэтому дальнейшее повышение точности приходится обеспечивать структурными методами и в связи с этим в настоящей работе проведен анализ потенциальных возможностей симметричного двунаправленного

ответвителя. Результаты анализа, проведенные в настоящей работе, позволяют утверждать в целесообразности применения рассматриваемого двенадцатиполюсника.

**Ключевые слова:** измерительный преобразователь, коэффициент отражения, двунаправленный ответвитель, СВЧ генератор, рефлектометр, симметричный двенадцатиполюсник, погрешность измерения, фазовая асимметрия, переходное ослабление.

**Summary.** Directional couplers of reflectometers have insufficient directivity, which leads to a decrease in the accuracy of measurement with a decrease in the reflection coefficient module. With the increase of the operating frequency of the microwave generator, the specified error component is also noticeably increased. It is no longer possible to increase the direction of the usual multiline coupler by technological methods, so further increase in accuracy is necessary to provide structural methods and in this regard, the analysis of the potential of the symmetric bidirectional coupler is carried out in this work. The results of the analysis carried out in this paper allow us to assert the expediency of the application of the twelve-pole.

**Keywords:** measuring transducer, reflectance, bidirectional coupler, a microwave generator, time domain reflectometer, symmetric twelve pole, measurement error, phase asymmetry, transient weakening.

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## **MALWARE: TYPES AND PROTECTION METHODS (REVIEW)**

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Today, we are increasingly using computers and other electronic smart devices in our life. Therefore, the problem of information security is becoming more urgent. The main threat to computer security is malicious

software (hereinafter - malware).

Malware can penetrate into information systems (hereinafter - IS) in different ways. Depending on the method of distribution, there are such types [1] [2]:

- Exploit is a theoretically innocuous data set (for example, a graphic file or network packet) that is incorrectly perceived by a program that works with such data type.

- The Trojan-program does not have its own propagation mechanism
- A computer worm can spread via e-mail, chat rooms or various computer networks by exploiting the vulnerabilities of network drivers
- A computer virus can be embedded in other programs, mainly in files with COM and EXE extensions, but it can also infect the boot sector of the disk or the MBR (Master Boot Record)

The type of malicious load classifies Malware, and we can divide them into following types [1]:

- Interference with the infected computer: from the opening and closing of the CD-ROM tray to the destruction of the data and the breakdown of the hardware.

- Installation of other malicious software
- Theft, fraud, extortion and espionage for the user. For theft, you can use hard disk scanning, register keystrokes (Keylogger), and redirect the user to fake sites that exactly match the original resources.
- Other illegal activities. For example, an infected computer (as part of a botnet) can be used to conduct DDoS attacks (hacker attack on the computer system in order to bring it to failure [9]).

There are different ways to protect against malware [4]:

- Use operating systems that do not allow changing important files without the user's knowledge
- Install updates in a timely manner
- Use external storage media only from trusted sources on the work computer
- Do not open computer files received from unreliable sources on the work computer
- Use antivirus software

Most of the protection methods help prevent the virus from entering the IS, but they are not always reliable enough. After penetrating the IS, one of the tasks of malware is to hide the fact of infection. To do this, the computer virus polymorphism can be applied - a special technique that reduces the level of detection of malware by classic antivirus products. Polymorphism consists in the formation of the program code of the malicious program already at runtime, while the procedure that forms the

code itself should not be permanent and mutated with each new infection. Frequent modification of the program code does not allow creating a universal signature for a given sample of the malware [3]. Antivirus software helps to prevent the harmful effects of viruses that have already entered the system. There are three main ways to detect malware:

- Signature analysis
- Heuristic analysis
- Code Emulation

Signature analysis is the most common method of antivirus protection, which consists in identifying the characteristic identifying properties of each virus. Then created signatures used for comparison with suspicious files. This method provide high performance and a low percentage of false positives, but its main drawback is that it is unsuitable for protection against new viruses. It is impossible to create a signature until the experts do not analyze the new virus [5]. In addition, this method is ineffective against polymorphic viruses.

Heuristic analysis significantly complements the method of signature analysis. It uses the signature of previously known viruses as an object of analysis, and knowledge about the mechanism of signature polymorphism - as rules for heuristic verification [6].

The code emulation method allows antivirus to detect encrypted malware. It consists of a decryptor and encrypted malicious code that cannot be recognized before the program is launched. Besides polymorphic viruses is also detected. Code emulation method provide virtual execution of the code of the program. Thus, the virus independently decompresses and decodes the malicious code, which is easier to recognize using the analyzing methods. During of the process of emulating the malicious code execution, IS remains isolated from harmful effects. This method can't be used for real-time scanning, because emulation process takes too much time and resources of the computer [7].

You can see that now there are not enough reliable methods of protection against malware. This leads to contemporary problems in the field of information security, such as botnets of personal computers or smart devices [8], designed to carry out massive DDoS attacks or viruses, stealing money during the transaction [10]. Thus, we consider that a low level of information security is a global problem.

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**Аннотация.** В статье рассматривается актуальная проблема информационной безопасности. Угрозой для безопасности информационных систем является вредоносное программное обеспечение. Существует несколько критериев для классификации



вредоносного ПО, например, вредоносная нагрузка и способ распространения. Одним из решений данной проблемы является использование антивирусных программных продуктов. Антивирусы используют различные способы обнаружения вредоносного ПО, а зависимости от его типа. К сожалению, невозможно обеспечить полную безопасность информационной системы с помощью существующих на данный момент решений.

Авторы приходят к выводу о том, что проблема информационной безопасности становится все более острой и актуальной.

**Ключевые слова:** информационная безопасность, программное обеспечение, вредоносный код, вредоносной ПО, антивирус, DDoS-атака.

**Summary.** The current problem of information security is considered in the article. The threat to the security of information systems is malicious software. There are several criteria for classifying malware. For example, malicious load and the method of distribution. One of all solutions of this problem is the use of antivirus software. Antiviruses use different ways of detecting malicious software, and depending on its type. Unfortunately, it is impossible to ensure complete security of the information system using existing solutions.

The authors conclude that the problem of information security is becoming more acute and urgent.

**Keywords:** information security, software, malicious code, malware, antivirus, DDoS-attack.

UDC 004.9

## THE ROLE OF SOCIAL NETWORKS IN THE ELECTORAL SYSTEM

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Throughout their lives, everyone makes decisions and is largely responsible for them. Depending on the possible consequences, people spend a different amount of time thinking and making decisions. But there are situations when it is necessary to make a responsible decision quickly. In this case, it is necessary to seek advice from others or to make decisions based on their own experience or previous decisions on the same issue by other people, or taking into account their views on the adoption of this decision, which are supported by reputation, trust and influence.

Consider the main factors of the social network and the electoral system. The *social network* is a social structure consisting of a set of individual or collective agents/subjects and a set of relations defined on it which are considered as sets of relations between agents (acquaintance, friendship, cooperation, communications). Formally, this network is a graph  $G(N, E)$ , containing a finite set of vertices  $N$  and a set of edges  $E$ , reflecting the interaction of agents [1].

In different sources is called about 20-30 main factors of social networks, among which the most significant are:

- own opinions of social network agents;
- significance of opinion (influence, trust), some agents for other agents;
- exposure to agents of influence (conformity, stability);
- the activity of agents (goal-oriented behaviour);
- information management in social networks.

The main factors of the electoral system that are the focus of attention of numerous international organizations during the elections are the following [2]:

- respect for the civil and political rights of voters and candidates;
- adequacy of completeness and consistency of voter lists;
- equality of access of candidates to the media;
- free access of domestic and foreign observers;
- women's participation in the electoral process;
- the participation of national minorities in the elections;
- ensuring access to polling stations for persons with disabilities;
- integrity of the vote counting process and summary of results;
- the effectiveness of the procedure of consideration of complaints and appeals to independent judicial bodies;
- total transparency and accountability, which strengthens the

confidence of the population;

- development and application of new voting technologies.

It can be concluded that the combination of these factors allows us to consider the social network as a social structure with a specific Internet implementation, to which the technology of "big data" can be applied [5]. Social networks can be used at different stages of the electoral process for the following purposes:

- votes;
- qualimetry of public opinion, psychometric and sociometric analysis, determination of voter's mentality;
- selective correction of the views of the subjects of the election process on the basis of models of influence in social networks [4].

Note that the electoral process is characterized by the following stages [2]:

- designation of election day and the beginning of the election campaign;
- the establishment of electoral districts;
- formation of polling stations;
- the creation of a special electoral bodies;
- voter registration nomination and registration of candidates;
- agitation campaign;
- vote;
- vote counting and determination of election results and their publication;
- possible second round of voting and new (re -) elections;
- the establishment of the final election results and publish them.

Obviously, the key stage of the electoral process is the voting stage.

Of particular interest in identifying the preferences of voters are the possibilities of the method of analysis of hierarchies, which is a closed logical structure that provides simple rules analysis of complex problems in all their diversity and leads to the best answer [3].

A voter faced with the problem of judging the suitability of a political candidate often has doubts about the indicators/criteria by which the assessment should be made. Moral character and honesty are important for a person of high morality. The unemployed person is likely to pay attention to the internal economic development programme proposed by the candidate. If a person cares about the security of his / her country, the candidate's competence in international relations will receive priority in his / her assessments. But what to do if the voter is susceptible to all these considerations to varying degrees?

The first step is to choose the questions essential for the candidate. The position of the candidates on these issues forms the criteria to be evaluated. Many questions can be arbitrary, but some are more meaningful than others.

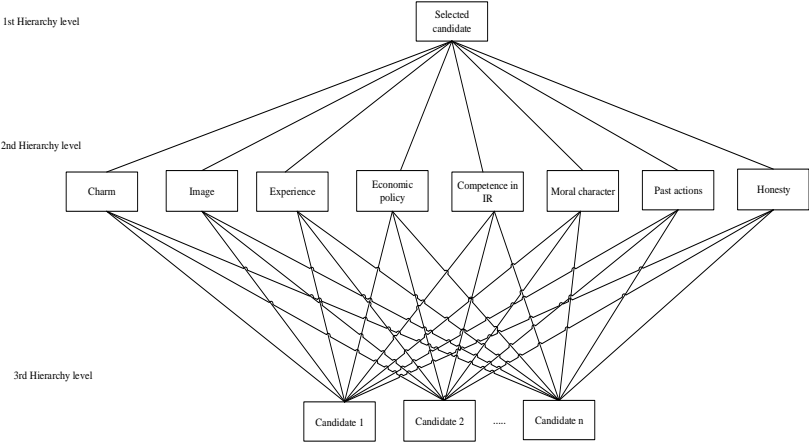


Figure 1 — Model of the "candidate selection" hierarchy from the voter's point of view

As an example, consider the hierarchy model shown in figure 1, where the first level of hierarchy is the global objective of the decision — making; the second level is the main criteria/issues to be considered during the voting; and the third level is the outcome, in this case, the list of candidates, one of whom must be voted on. These criteria are compared in pairs according to their relative contribution to the overall success of the presidential candidate [3].

There is no doubt that democratic elections are the result of collective action by people who are traditionally directed by the media.

Assessing the role of collective action in social networks, it should be noted that social relations play a key role here.

The influence of social relations is manifested in the following.

1. On the one hand, social connections can provide effective local social control to encourage participation in collective action (behavior of agent's neighbors affects his own behavior).
2. Social relationships provide the agent with information about the intentions and actions of other agents in the network and forms its incomplete representations on the basis of which the agent makes a decision.
3. Within social bonds agents can make joint efforts to create a local and public benefits and to share them.

Thus, the structure of the social network has a strong impact on the decisions of agents in taking part in the collective action [1].

Comparison of the main factors / criteria of the social network and the model of the hierarchy "choice of candidate" suggests that these factors complement and partially replace each other with different views on the same collective actions (in our case, the electoral process). An example of such a factor is reputation.

Conducting campaign, each candidate seeks to gain the greatest number of votes in their favor. To do this, he must have a strong positive reputation, which depends on the opinion and confidence of the voters in this candidate.

Therefore, reputation can be considered, firstly, as expected by other agents norm of the agent. Second, as the "weight" of the agent's opinion, determined by the previous justifiability of his judgments and/or efficiency of his activity. Reputation, as a rule, increases if the choice of the agent coincides with what is expected from the rest of him and/or what the rest later, consider the norm. Reputation may also decrease, for example, in case of violation of the subject's accepted standards of behavior in the community or in the case of ineffective decisions [1].

Quantify the reputation of the network agent can be evaluated by some nonnegative parameter. Then the reputation vector of all agents can be considered a General knowledge among agents. Given that the network is a complete graph, we can conclude that the resulting opinion will be the same for all agents included in the considered social network. Also, to analyze the behavior of network agents, it is necessary to take into account the degree of influence of agents on each other, which is proportional to the reputation of agents.

When modeling agent reputation dynamics, it is assumed that their interaction is repeated sequentially a finite number of times. Agents can consistently discussing a number of questions, and the reputation of each agent in the General case depends on the "all prior history" of the discussion.

To describe the entire trajectory of changing the opinions and reputation of agents, it is necessary to determine how the reputation of each agent changes in each period of time. Therefore, it should be borne in mind that, firstly, reputation is a "cumulative" characteristic (forgetting is absent) and, secondly, the reputation of the agent at the beginning of a certain period of time depends only on its reputation in the previous period, as well as to what extent its initial opinion was different from the resulting opinion of all agents by the end of this period. In other words, the reputation of the agent increases (decreases), if the final opinion of all agents is close to his

opinion (very different from his opinion).

The research, which is this article devoted to, continues the development of scientific ideas about modern ways of holding collective events and their active implementation through information technology, as well as the monitoring of users of social networks. Modern technologies allow to simplify electoral procedures, in particular, to introduce "remote Internet voting". However, according to a number of lawyers who are skeptical about this innovation, such a method of voting does not determine whether the person made the decision or he was pressured. In a traditional voting environment, a closed booth and the exclusion of anyone other than the voter is a reliable factor of independence in decision-making and allows any external pressure to be recorded. At the same time, under the conditions of electronic voting, it is practically impossible to check the freedom to choose a voter [2]. In particular, Britain's withdrawal from the EU and the victory of one of the contenders for the presidential elections in 2016 in the United States became possible thanks to the total manipulation of public opinion in social networks in the interests of eurosceptics and opponents of the American version of globalization. And modern technologies of "big data" analysis were used for this purpose [4].

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**Аннотация.** В статье обсуждаются роль социальных сетей в избирательных системах государств с демократической формой правления. Анализируются основные факторы социальной сети и

избирательной системы. Рассматривается динамика ключевых факторов социальной сети на примере избирательного процесса «выбор кандидата». Отмечается взаимное дополнение/замещение факторов социальной сети и рассматриваемой модели избирательного процесса, а также сильное воздействие структуры социальной сети на решения агентов о принятии участия в коллективном действии. Обращается внимание на возросшую роль информационных технологий «большие данные» в формировании мнений избирателей.

**Ключевые слова:** избирательная система, социальная сеть, модель иерархии, агент, социальные связи, репутация.

**Summary.** The article discusses the role of social networks in the electoral systems of States with a democratic form of government. The main factors of social network and electoral system are analyzed. The dynamics of the key factors of the social network on the example of the electoral process "candidate selection" is considered.

**Keywords:** electoral system, social network, hierarchy model, agent, social relations, reputation.

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## **ANALYSIS OF VIDEO FRAME FOR HIGH SPEED TRANSMISSION BY 3G CHANNEL**

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In the article, the problem of remote control signals transmission for unmanned vehicle by the 3G channel (though mobile wireless networks of standards IEEE802.21) is considered. From the specification, the maximum speed of data transmission though 3G networks is 2 Mbit/s for stationary devices and 384 kbit/s for low speed mobile devices and nearly 144 kbit/s for high speed mobile devices [1]. Such values of speed are only the

standards requirements, but in real networks the speeds of packet transmission more slow. So, to understand the opportunities of a 3G channel for video data transmission, the analysis of limits were done and presented in table 1.

Table 1 — Estimation of time for video frame transmission

	for (144 kbit/s):		for(384 kbit/s):	
Frame dimensions:	320x240	160x120	320x240	160x120
Frame depth:	24 bit	1 bit	24 bit	1 bit
Frame value: (resolution*depth)	230400 byte	57600 byte	230400 byte	57600 byte
One frame transmission time (without compression)	12,5 sec	3,125 sec	4,688 sec	1,172 sec

The video data can be transmitted though the wireless mobile network as:

- set of MMS messages, which are send to special number of network;
- pictures send to e-mail or FTP-server;
- video stream in real time (the type of transmission, which is suitable for remote control of unmanned vehicle tasks).

To provide the high speed transmission of video data, the following block diagram (see fig. 1) was proposed [2].

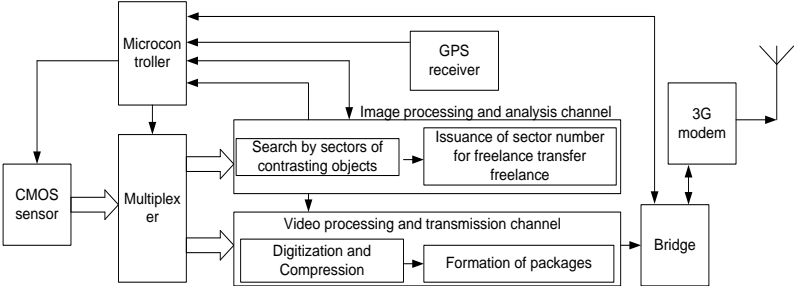


Figure 1 – Block diagram of unit of generation, processing, and transmission of video data

From the fig. 2, one can see that the structure of the unit is based on parallel processing of video frame for its next compression and transmission, and also for generation of extra package in case of detection of dangerous objects on the video frame.



So, the signals from the CMOP-matrix (image segments with different sizes), come on the inputs of two channels, which are:

— channel of processing and analysis of video frames for detection of dangerous objects in different segments of video frame (for creation and transmission the extra package with important segments);

— channel of processing and transmission video data (segments) with adaptive compression.

Because of impracticality of full frame transmission, the principle of separate segments transmission is proposed to increased the transmission speed. The order of segments transmission is specified by its priority, as you can see on fig. 2.

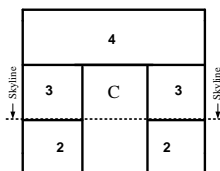


Figure 2 – Video frame division on segments

The principle of division of segments is specified by its priority as follows: the central zone with maximum priority occupies 40% of frame; the other zones with low priority are:

- 2 is edge periphery (below the horizon), which is transmitted frequently (20% of frame);
- 3 is the middle periphery (above the horizon), which is transmitted rarely (20% of frame);
- 4 is the sky area, which is transmitted occasionally (20% of frame)/

So, the main idea is to transmit the full frame in several (four) packages in usual situation (without maneuver). The sequence of segments are: C+2, C+3, C+2, C+4. So, the 1 package will have only 60% of frame, but the important part of frame (center) will be transmitted all time, and the other important segments will be transmitted frequently.

In case of compression in transmit channel, the analysis of popular compression methods was done. The most interesting are *MPEG-4*, *H.264*, *H.265*. All this methods are base on using the Discrete Cosine Transform (DCT) and prediction [3]. So, the proposed [2] block scheme of unit is based on program realization of compression scheme *H.264* in *DSP*-microprocessor but with the modification where a created signal of forecast vector  $P_i$  is transmitted only if the difference of next and previous analyzed sectors not exceed 50 %. In this case the forecast signal is equal 0 and the full segment will be transmitted after its processing and compression, as you can see of fig. 3.

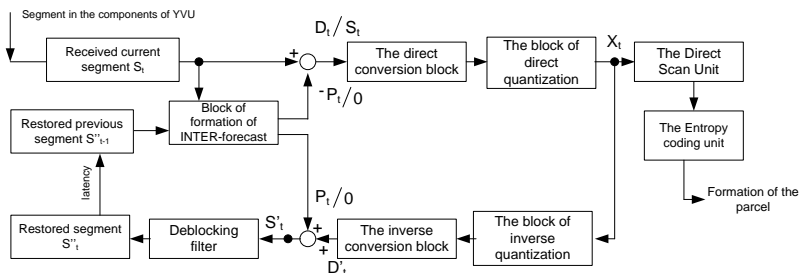
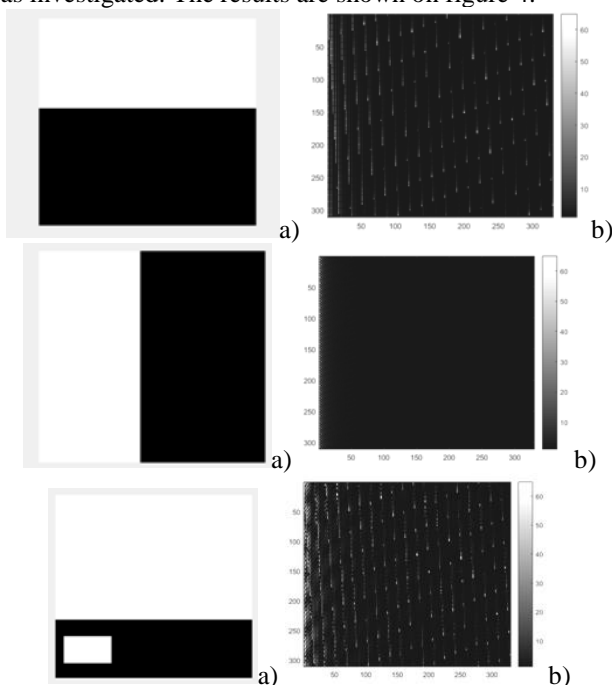


Figure 3 — Block diagram for compression algorithm in channel of processing and transmission of video frame

Because of necessity using at the unit (see fig.1,3) the Discrete Cosine Transform for every segments of video frame, the question of usefulness of such transform for purpose of quick detection of dangerous objects on the frame (segment) is can be discussed.

To verify the opportunities of using the DCT in the task of quick detection of dangerous objects, the influence of simple geometric lines and figures was investigated. The results are shown on figure 4.



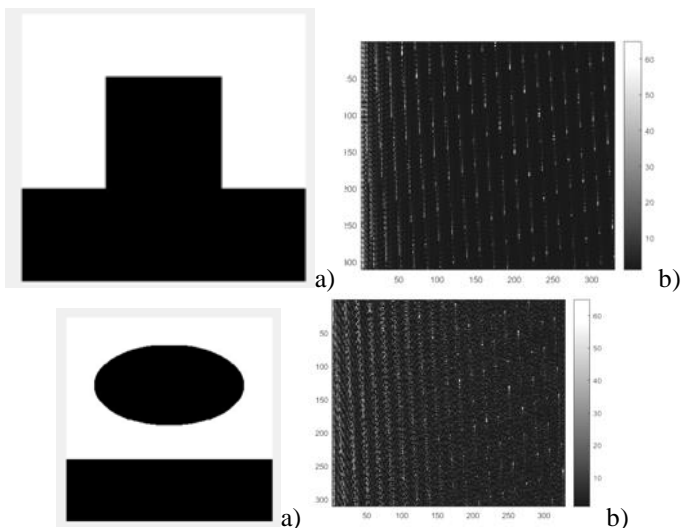
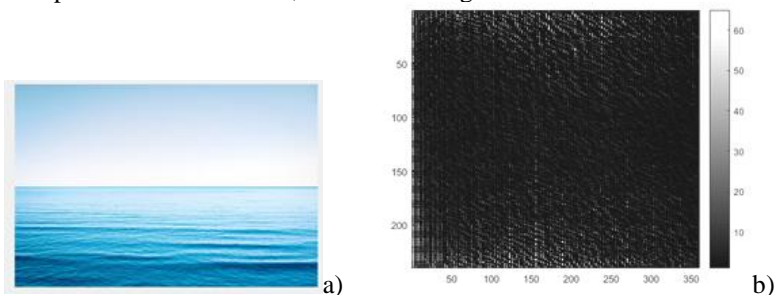


Figure 4 – The results of study of influence the simple geometrical lines and figures on the DCT (frames (a), DCT (b))

From the figure 4 we concluded that the high impact on the whole area of DCT can be made by the horizon division line (the division line see-sky), and the impact of vertical division line limited by the small left area of DCT. In case of horizon line the DCT has periodical vertical inclined lines with local maximums on its. And also, implantation of extra object in the study area (for example, black square above the horizon as the simple model of vehicle, or the white rectangular under the horizon as obstacle at the side) is leads to modification of DCT (on its left side the frequency of lines are higher). In case of extra oval object (the model of complex object on the see), the function of DCT is more “noisy” and the periodical lines are blurred.

The described properties of DCT from the simple figure, can be seen in complex real video frames, as shown on fig. 5.



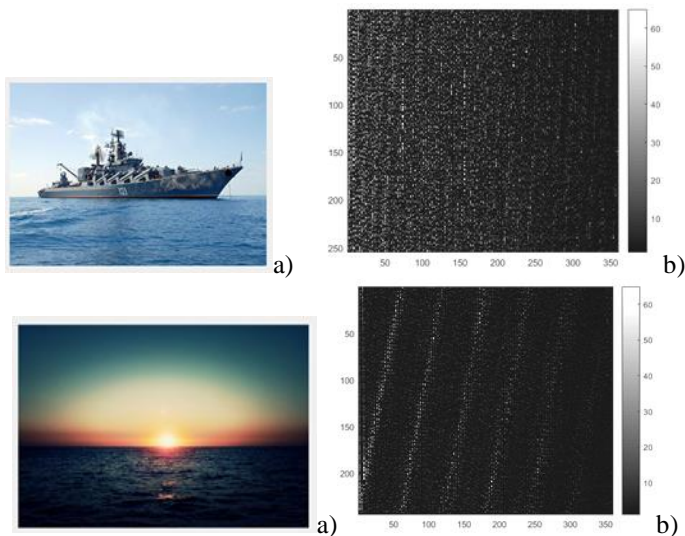
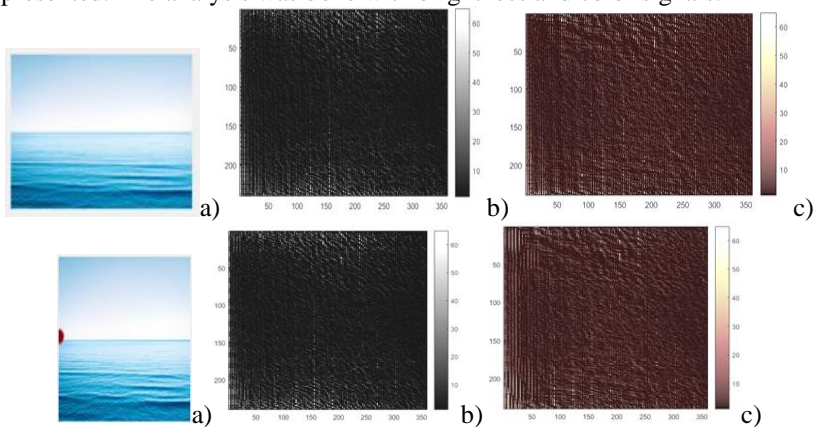


Fig. 5. DCT from real video frames

From the figure 5, the conclusion of inexpediency of DCT from the full video frame was done. The reason is the influence of clouds and sun is slightly different from the impact from the ship and obstacles. But on the other side, the using DCT from the segment of video frame can allows to detect the changing in the field of view with the special method of DCT analysis and initial calibration.

So, on the figure 6, the results of model experiments with the implantation in the frame obstacles with different values and color are presented. The analysis was done with brightness and color signals.



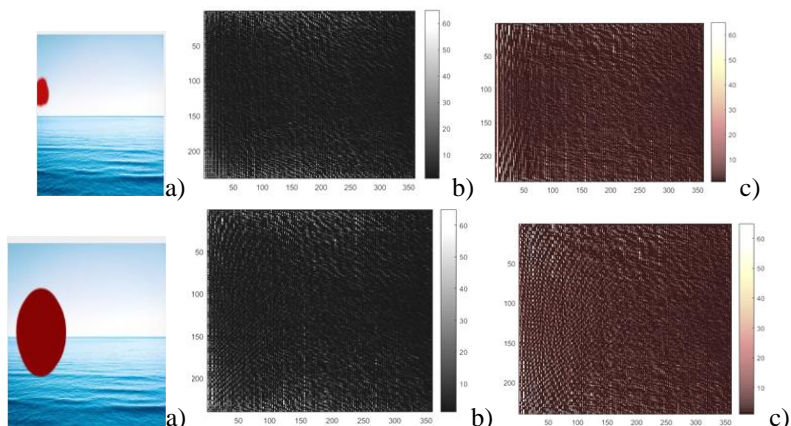


Figure 6 – Implantation in segment 2 (video frame (a), brightness DCT (b), color DCT (c))

As you can see from presented function of DCT, even if the small object will show up on the edge of segment, it will be simply detect from the analysis of DCT function.

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**Summary.** By way of a solution to the problem of the transmission of video images over a limited communication channel, the application of an algorithm for image transmission along with their adaptive correction and compression is suggested. A block diagram of the block of formation, processing and transmission of video images has been developed, an algorithm for the operation of the unit and a subprogram for controlling the

transmission channel of large segments have been developed too. The possibilities of application of discrete-cosine transformation in the problem of fast response to the controlling remote center are considered.

**Keywords:** remote control of an unmanned object, transmission of video images over channels with limited bandwidth, 3G, method of adaptive video signal generation, discrete cosine transform.

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## **METHOD OF BUILDING A MOBILE SENSOR NETWORK AT A FLAT ABSORBING SURFACES ENVIRONMENT**

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### **I Introduction**

There are a lot of researches devoted to sensor networks building. A wireless sensor network is a distributed, self-organizing network of many sensors and actuators interconnected via a radio channel. The coverage of such a network can be ranged from several meters to several kilometers due to the ability to relay messages from one element to another. Sensor networks consist of various types of sensors, such as seismic, magnetic field sensors, thermal, infrared, acoustic, etc. that are able to carry out a variety of environmental conditions measurements.

Wireless sensor networks can be an integral part of military, communications, intelligence, surveillance and targeting systems (C4ISRT). Rapid deployment, self-organization and fault tolerance are the main characteristics of sensor networks that make them a promising tool for solving tasks.

Partially, one of the most actual direction of this area is related to mobile wireless sensor networks (MWSNs). MWSNs are much more versatile than static WSNs as the sensor nodes can be deployed in any scenario and cope with rapid topology changes [1].

While the coverage of a sensor network with stationary sensors has been extensively explored and is relatively well-understood, researchers have only recently started to study the coverage of mobile sensor networks.

Most of this work focuses on algorithms to reposition sensors in desired positions in order to enhance network coverage [2].

This article describes one of the method of building a mobile sensor network at a flat absorbing surfaces environment.

## II Main definitions

Wireless sensor networks consist of tiny computing and communication devices called motes (from English “motes”— specks of dust), or sensors. Motes are some small boards that consist of processor, memory-flash and operational, digital-to-analog and analog-to-digital converters, RF transceiver, power supply and sensors (Figure 1). Mote is powered with a small battery. Motes are used only for collecting, primary processing and transmitting sensor data.

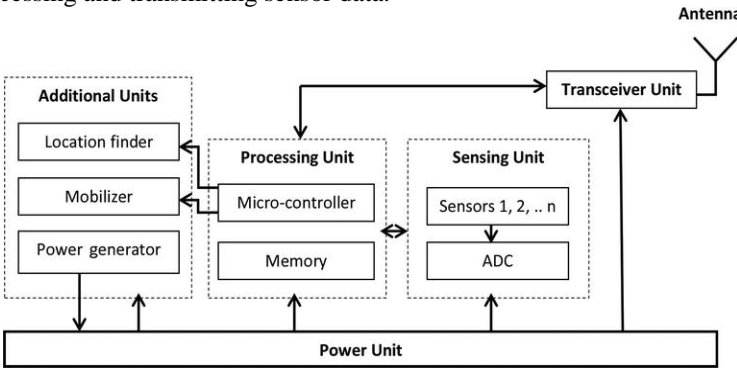


Figure 1 – Architecture of the mobile sensor node

The main task while building a MWSN is to determine an optimal amount of motes that can make a full bypass of a previously unknown labyrinth (labyrinth is an environment of propagation of signals with flat non-metallic non-reflective boundaries (facades of buildings, walls and partitions) and corridors) and make it possible to obtain information about the current state of the environment (temperature, movement or sound in the current location of the sensor and the area covered by it) throughout the maze.

Also we suggest that signals passing from node to node can be transmitted only in a straight line. It means that there should be a connecting node (or a few of them) that gains all the signals from the separate part of the maze and sends them to a main node. All of these restrictions tell us that MWSN that satisfies them should have a cluster topology, illustrated in Figure 2.

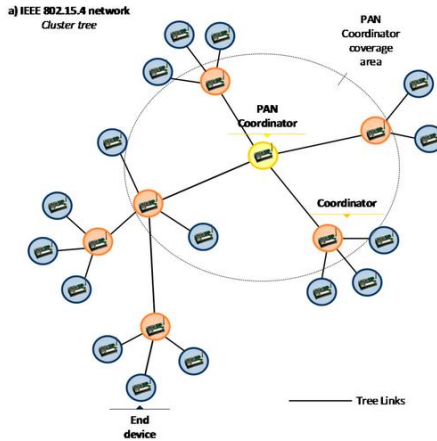


Figure 2 – Cluster topology

Figure 1 also demonstrates the use of IEEE 802.15.4, which describes the physical layer and the level of access to the environment for short-range wireless data networks (up to 75 m) with low power consumption, but with a high degree of reliability. This standard is related to WPANs (Wireless Personal Access Networks).

It is obvious that the importance of considering the task of organizing the interaction of motes with restrictions given below is due to both practical aspects of the deployment of sensor networks, taking into account the nature of the terrain, and the theoretical value of building distributed computing systems with elements of "swarm intelligence" on the basis of motes.

Such systems consist of a set of simple agents interacting locally with each other and with the external environment to achieve a predetermined goal. The interaction of the agents allows to achieve synergistic effect and successfully solve a great complex of problems. An example of such systems from nature is a colony of ants, a swarm of bees, a flock of birds, a shoal of fish. Each of these systems is characterized by relatively simple behavior of individual elements and complex intellectual common behavior.

Let's have a set of particles that we call a swarm.

Element of the swarm will be called, for short, SEL (Swarm Element). SEL can move only one step on the operational field in one stroke of the model algorithm in any direction. Directions are oriented around the world. We assume that the 2d area there the swarm operates, permits the stepwise movement of all elements of the swarm at the same time. Movement is possible if there are no obstacles in the chosen direction. By obstacles we will understand:



- the border region;
- the walls of the maze;
- other SELs.

Let's assume that the SELs do not interact with each other in terms of information exchange, the action of each SEL is autonomous and independent, what is reflected directly in the algorithm of its behavior [3].

### **III Q-learning algorithm**

The initial objective of sensors is a full survey of areas to determine the “thin places”, optimal location of sensors, routers and determine their field of “visibility” for the ordinary motes-researchers.

There are a number of algorithms to pass the previously unknown maze. One of the simplest rules for passing the maze is the rule of “the one hand” – while moving through the maze, you must always touch its wall with your right or left hand. This algorithm was probably known to the ancient Greeks. We will have to go a long way, going into all the dead ends, but in the end the goal will be achieved.

The fact that the maze is unknown in advance, the implementation of the Q-learning algorithm, based on the concept of “training with reinforcement”, is a very interesting method to solve the given task.

The response of the environment to the decisions taken are some signals of reinforcement, so such training is a special case of learning with the teacher, but the teacher is the environment or its model. The agent acts on the environment, and the environment acts on the agent. This type of the system has a feedback. Such a system should be considered as a whole, and therefore the partition line between the environment and the agent is rather conditional [4].

The agent is trained through the experience. It acquires with moving from one cell to another. Such training is called “teaching without a teacher”. In Q-learning, the agent adheres to certain rules of behavior  $\pi(S)$  (the best among those used by the agent before) and with their help moves in a cellular environment. The ultimate goal is to find the optimal (most reasonable) rules of conduct, i.e. the rules that bring the greatest reward for the lifetime of the agent. The optimal rules are denoted by  $\pi^*(s)$ .

The agent has a set of actions  $A(a_1, a_2) \dots a_n$  (in our case  $n = 4$  – “move to” North, South, West, East). The actions of the agent affect the environment, and the agent is able to determine in what state it stays at the moment and receives a reward from the environment for its actions  $R(a, s)$ .

To build an environment, it is important to determine all possible states of the environment  $S(s_1, s_2) \dots (s_n)$ . As well as the transition matrix  $T(s, a, s')$ , which contains the probability of reaching the state  $s'$ , if the state  $s$  action  $a$  was performed. It is assumed that these transitions are Markov in

the sense that the probability of reaching the state  $s'$  of  $s$  depends only on  $s$ , not on the history of previous states. At the moment, the record  $t(s, a, s')$  can be considered as a large three-dimensional table containing probabilities.

The agent's task is to find the best strategy. In this case, it will be described by  $Q$ -values, which determine the usefulness of the executed action in the appropriate state.  $Q(a, s)$  will be used to denote the cost of performing action  $a$  in state  $s$ .

Network can be called built when all of the motes achieve two main goals:

- 1) The maze is fully explored, all thin places are known, so motes can stay at their current places;
- 2) The network has decided which of the motes should become a commutator and routers.

#### **IV Conclusion**

MWSN is not a breakthrough at the world of information technologies, but this way of monitoring can be really useful nowadays. Such mobile sensor networks are extremely valuable in situations where traditional deployment mechanisms fail or are not suitable, for example, a hostile environment where sensors cannot be manually deployed or air-dropped. Also, it can be used at homeland security systems, etc.

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**Аннотация.** В данной статье рассматриваются и анализируются основные аспекты, которые стоит учесть при разработке мобильной сенсорной сети в средах распространения с заранее неизвестными плоскими неотражающими границами; в частности, затронут алгоритм обучения поведения элементов сети с помощью алгоритма Q-обучения

на основе метода роя частиц.

Вопрос о построении таких узкоспециализированных сетей является актуальным и становится актуальнее с каждым днём. Потому изучение данной темы и разработка программного продукта, позволяющего моделировать реальные объекты в программной среде – задача, которая имеет большую важность не только в рамках учебного процесса, но и для решения реальных задач.

**Ключевые слова:** мобильные беспроводные сенсорные сети, моты, кластерная топология, роевой элемент, алгоритм Q-обучения,

**Summary.** This article discusses and analyzes the main aspects that should be notices while building a mobile sensor network in distribution environments with previously unknown flat non-reflective boundaries; in particular, the algorithm of studying the behavior of network elements using the q-learning algorithm based on the particle swarm method.

The question of building these ad-hoc networks is relevant and becomes more relevant every day. Therefore, the studying of this topic and the development of a software product that allows to model real objects in the software environment is a task that is of great importance not only in the educational process, but also for solving a number of real problems.

**Keywords:** mobile wireless sensor networks, motes, cluster topology, swarm element, Q-learning algorithm.

**DEVELOPMENT OF DIGITAL REAL TIME CLOCK****Anton Varshavsky**

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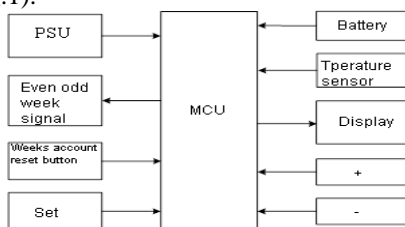
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**1. Introduction**

For the electronic Cathedral stand, it is proposed to develop an electronic real-time clock with a functional extension for the possibility of introducing additional functions such as: calendar, display signal indication of even or odd weeks and indoor temperature measurement. This functional expansion of the electronic clock is possible through the use of a temperature sensor and a microcontroller, the software, which integrates all the above mentioned additional functions. The task of the developed device is to fill the cluster of the electronic stand and raise the awareness of students.

**2. Main part**

To make a structural scheme, we analyze the main functions of the designed device and produce its division into structural units. Structural units reflect the main modules that will be included in the implementation of the device (Fig.1).



**Fig.1 Structural Scheme of Digital Real Time Clock**

Power supply unit (PSU). Secondary power supply — a device designed to provide power supply to the digital circuit of the developed device and charge the backup battery.

Battery pack. It is used to maintain the continuous operation of the circuit by ensuring uninterrupted power supply of real-time hours in cases of unforeseen power outages when the device is de-energized.

The microcontroller unit (MCU). To perform convenient data processing, such as calculation of the mi-nut, hours, temperature, even odd week and display the relevant data on the indicator, for which a special software is developed. The second task of MK is to control electronic clock modules [1, p. 184].

Display unit. Designed to display hours and minutes in display mode and setup mode. Led four-digit seven-segment indicator is used for this unit [3, p. 557].

In the led indicator used in the common cathode circuit, nine outputs: one is connected to the cathodes of all segments and discharges, and the other eight are connected to the anode of each segment. To realize a compact printed circuit Board and reduce the number of IC terminals involved, a shift register can be used when working with the indicator, as well as a dynamic display mode [2, p. 166]. To improve the readability of the watch it is supposed to use indicators in the size of 6 inches, which require a supply voltage of 12 V. Transistor-based drivers are used to control the indicator using MK.

Blocks of buttons consist of four buttons. The “SET” button performs the function of selecting the clock selection mode. One mode is setting the hours and minutes, and the other is real-time display. The “+” and “-” buttons perform the function of increment and decrement, respectively, and are used to set the clock [4, p. 558].

A separate IC output is used to generate a signal for an even or odd school week. To do this, the software MK will be implemented calendar. To start the week counter, there is a reset button “Reset weeks account” [5, p. 228].

To maximize the possibilities of MK, a digital temperature sensor for indoor air temperature measurement has been added.

### **3. Conclusion**

To enable the functional performance of the block diagram, the software for MK was partially developed and implemented. Simulation of the circuit and the program showed that the digital circuit operates correctly.

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**Аннотация.** В статье излагается разработка цифровых часов реального времени со встроенной функцией измерения температуры.

Электронные часы рассматриваются в работе как часы, в которых периодические колебания электронного генератора используются для считывания времени, преобразования в дискретные сигналы, повторяющиеся за 1 с, 1 мин, 1 ч и т. д. При этом сигналы выводятся на цифровой дисплей, показывающий текущее время, а в некоторых моделях также число, месяц, год, день недели.

**Ключевые слова:** электронные часы, Батарея, Микроконтроллер, Клавиатура, Семи сегментный индикатор.

**Summary.** The article describes the development of a digital real-time clock with a built-in temperature measurement function.

Electronic clock is studied in the work as a clock, in which the periodic oscillations of the electronic generator are used to read time, convert to discrete signals, repeating in 1 s, 1 min, 1 h, etc. The signals are output to a digital display showing the current time, and in some models also the number, month, year, day of the week.

**Key words:** electronic clock, Battery, Microcontroller, Keypad, seven-Segment indicator.

UDC 004.55

## MULTIMEDIA TECHNOLOGY. DEFINITION AND APPLICATION.

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Multimedia-a combination of the ability to create video and audio effects under the control of interactive software.

Video effects must be accompanied by audio effects: music, speech, etc.

Until the 1990s, the available funds did not allow:

1. To obtain high quality sound.
2. To perceive and produce speech.
3. High image quality.
4. Creating the simplest video and audio effects was time-consuming, and required long-term work and experienced professionals.

These difficulties are due to the fact that the video and audio information was analog, and the PC - works with digital. Converting analog information to digital requires complex coding and a large amount of memory.

Overcoming the shortcomings required the development of:

1. New technical solution.
2. New algorithm.
3. New software.

Multimedia - a combination of special latest hardware and software, that allow a qualitatively new level to perceive, reproduce, process video effects and audio effects, which makes it possible to create virtual reality.

**There are two aspects of the presentation of multimedia information - hardware and software.**

Hardware:

1. Audio adapters (the device to pair the information source with the computer). Made in the form of fees, which is inserted into the slot on a motherboard and allows you to connect microphone, speakers, and etc. in the composition of the audio adapter included:

- Converter of sound information to digital;
- a compression of the received digital information;
- the mixer (a device for mixing sounds);
- synthesizer.

2. The appearance of drives on CDs was based on the principle of audio CDs, allowing to store information in a fundamentally larger scale.

3. Video adapter allows you to create images of television quality and display it on the screen of a PC, TV, etc.

Software:

1. Hardware. Software supplied with ROM.

2. Software. Software loaded from ROM to RAM.

Composition: operating systems, drivers, utilities, special software (creating video effects, audio effects).

**Application:**

1. In gaming. Characterized by stereo sound, graphics, a large number

of game situations.

2. In the family. Entertainments.

3. Training. When the lecture digest - 0.25 information, and the use of computer - 0.75.

4. In programming. Freed professionals from the programming dialogue and various visual effects. The creation of special multimedia programs that are invoked as command files, and algorithmic languages.

5. Information support. The possibility of creating a CD-ROM, database and help system.

6. Business. Personnel training, marketing and document management.

7. Cartography.

8. Catalogs of collections.

9. Linguistics.

### **The use of multimedia technologies.**

One of the main areas of application of multimedia systems is education in the broad sense of the word, including such areas as video encyclopedia, interactive guides, simulators, situational role-playing games, etc. A computer equipped with a multimedia board immediately becomes a universal training or information tool for almost any branch of knowledge and human activity - it is enough to install a CD-ROM with the appropriate course (or place the required files on the hard drive).

Very great opportunities for media in medicine: knowledge base, methods of operations, directories, drugs, etc. In the business firm real estate are already using technology and multimedia to create a directory of homes sold – the buyer can see the house in different angles to make interactive video pregnancy around the room, to see the plans and drawings. Processing multimedia enjoys great attention of the military: the Pentagon is implementing a program for the transfer of interactive video discs of all technical, operational and training documentation for all weapons systems, creation and mass use of simulators on the basis of these discs.

Multimedia technologies are fully gone in the conception of development of computer training technology. That's why we think that the combination of multimedia technology teaching is not correct and it is often used in the context of new educational technology. It should be emphasized that multimedia technologies have the same theoretical fundamentals as the technologies of computer training. It will be true to consider the multimedia computer technology training as a modern phase of technology development of computer training using the didactic possibilities of modern computer, new technologies of programming and instrumental surroundings for the development of computer means of training.[1]



In mathematical and scientific research, multimedia is mainly used for modeling and simulation. For example, a scientist can look at a molecular model of a particular substance and manipulate it to arrive at a new substance. Representative research can be found in journals such as the *Journal of Multimedia*. [2]

Occur fast company, specializing in the production of hypermedia publications-books, encyclopedias, travel guides.

Among the well - known products of the "encyclopaedic "plan-published in France by the society Act Information" Electronic dictionary", "Electronic encyclopedia " Groll, information Finder company World Book . All properties of multimedia has a full encyclopedia "Birds of America". All color images and accompanying text were taken from the original first edition.

The user hears the voices of birds recorded on the disc with the Participation of the library of natural sounds Cornell University.

The relatively large volume of the CD makes it an ideal medium for encyclopedic publications. The user "travels" through the encyclopedia using the keyboard or using graphic images, which include photos, maps, tooltip screens, electronic bookmarks and a dictionary consisting of 150,000 articles.

An example of the use of multimedia in art can be " musical CD-ROM, which allow not only to listen (with the highest quality) to the works of a composer, but also to view the scores on the screen, highlight and listen to individual topics or instruments, get acquainted with reviews. View text photos and videos related to the life and work of the composer, the composition and location of the orchestra and choir, the history of the device of each instrument of the orchestra, etc. Released, in particular, CD-ROM, dedicated to the 9th Symphony by Beethoven," Magic flute "Mozart," Spring sacred " Stravinsky. Another example is the inclusion of collections of art museums in interactive videodisks; these works are already underway in Russia.

In addition to " informational "applications," creative " ones that allow creating new works of art should also appear.

Already now the multimedia station becomes an indispensable author's tool in cinema and video art. The author of the film behind the screen of such a desktop system collects, "oranges", creates works from pre - prepared - drawn, filmed, recorded, etc. - fragments. It has virtually instantaneous access to each frame of footage, the ability to box "e" mount with frame accuracy. He is subject to all sorts of video effects, overlay and image conversion, manipulation of sound, "Assembly" of sound from sounds from various external audio sources, from the Bank of sounds, from

sound effects programs. Further, the use of processed or computer-generated images can lead to the emergence of a new visual technique in painting or film.

Works on introduction of artificial intelligence elements in multimedia system look very promising. They have the ability to "feel" the environment of communication, adapt to it and optimize the process of communication with the user; they adapt to readers, analyze the range of their interests, remember the issues that cause difficulties, and can offer additional or explanatory information. Systems that understand natural language, speech detectors further expand the range of interaction with the computer.

Another fast-growing, absolutely fantastic for us the scope of the computers, which plays an important role multimedia technology is a system virtual, or alternative reality and similar systems "telepresence". With the help of special equipment - a system with two miniature stereodisplays, quadrennium, special sensory gloves and even costume, you can "log in" in the generated or simulated by the computer world (and not to look at it through a flat window display), turning his head to look left or right, to go further, extending the hand forward and see her in this virtual world; you can even take any virtual object (feeling its heaviness) and rearrange to another location; therefore, to build, to create this world from the inside.

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**Аннотация.** Статья представляет собой описание мультимедийных технологий их функции и области их применения. В статье говорится о первопричинах возникновения современных мультимедийных технологиях. Рассматривается классификация по аспектам представления мультимедийной информации, а также широкое применение в различных сферах.

**Ключевые слова:** мультимедиа, мультимедийные технологии,

аспекты представления, классификация, области применения современных технологий.

**Summary.** Multimedia is a combination of innovative hardware and software that allows you to perceive, transform and reproduce video and audio effects at a high level, which makes it possible to create a virtual reality. There are two ways of presenting multimedia information: hardware (audio adapters, CD-ROM drives, video adapters) and software (Hardware and software). It is mainly used in games, business, cartography, especially in teaching, programming and medicine. It also extends to work with artificial intelligence and virtual (alternative) reality.

**Keywords:** multimedia, multimedia technologies, aspects of presentation, classification, application of modern technologies.

UDC 316.7

## **DIGITAL TECHNOLOGIES AS A TOOL OF DEVELOPMENT OF THE HISTORICAL AND CULTURAL POTENTIAL OF THE REGION**

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In the conditions of the formation of digital intelligence and the dominance of infocommunication technologies, when the last precede the priority resources of modern processes, it becomes necessary to analyze specific technologies of digital technologies in the sociocultural process. The development of modern Internet technologies and mobile electronics not only determined the creation of innovative resources and methods of communication, but also change the socioanthropological reality, the way of life, the modification in the types of perception of the world. Therefore, today there is a withdrawal from access to information, as well as the dissemination of interactive forms of "narrative".

Russia as a country with a rich natural diversity and cultural heritage is characterized by the uniqueness of the development of all regions without exception, possessing a powerful historical and cultural potential. It should be noticed that the historical and cultural potential is associated not only

with the actualization of values, but also with their rethinking, moving forward, that is, the dominant vector is the generation of the values of the future.

Every period of time leaves its step, that reveal in the original heritage of the historical development of the area. The peculiarity of the Russia regions is associated with a combination of unique objects of material and spiritual culture, and is represented by memorial places, historical monuments, religious buildings, folk crafts, national traditions and many others. That is, under the historical and cultural potential is understood the complexity of information of a diverse nature (natural, geographical, historical, cultural, ethno-social and other) that emphasizes the unique image of a particular territory.

The reunion of the Crimea with the Russian Federation in 2014 gave impulse to the development of the cultural potential of the city of Sevastopol, and for the purpose of preserving, popularizing and protecting the state, a number of objects (historical and cultural monuments) were included in the single state register of cultural heritage sites of the peoples of Russia [1].

Sevastopol is a city with a rich history and an abundance of sights. Among them, Chersonesos Tavrichesky, the medieval town Inkerman, the Genoese fortress; attractions associated with the Crimean War (1853-1856yy.); defense of Sevastopol (1941-1942) in the Great Patriotic War, as a whole in the city over 2 thousand historical monuments.

However, today it is not enough to have a solid historical and cultural potential, it is necessary to work skillfully (to develop and promote), creating image appeal of the region for tourists and investors. The image of the region (city) is the image of the region (city) that is formed in the minds of people and influences the prospect of its development [2, p. 71]. Each historical layer has its own myths and legends, artifacts that form a unique atmosphere of the place, about which they tell, on this builds its unique image. That is, it is a huge value reservoir of past centuries, which requires "processing" based on the application of new methods and technologies.

Of course, acquaintance with the history of the city is a long-term business, but the using of digital technologies can accelerate and dialogize this process. In this case, we are talking about the use of Augmented Reality (AR) technology, which produces reality combined by integrating virtual objects into the real world. Considering that today the information has become more context-dependent and determined by the surrounding conditions. For a person it becomes important to obtain the necessary data related to the object at a certain point in time. Therefore, it should be noted the feature of AR technology is the preservation of the physical world as a

context in which virtual objects are represented and with which they interact.

Today, tourism is able to become one of the drivers of city development (the "Smart City" project), therefore it is necessary to create a single digital tourist platform of Sevastopol [3]. In this direction, concrete steps are being taken. The team of teachers and students of the Institute of Information Technologies and Management in the technical systems of Sevastopol State University develops the application (C# and the interactive solutions engine Unity3d are chosen as the programming language), which contains all the information that the tourist needs to get acquainted with the main sights of our city. After downloading such application, you can point the camera of the device to the map of Sevastopol and after that marks will appear on it (fit to certain sights), when you click on them you will go to the viewing mode. All the same is available in the form of an ordinary list of sights.

At the moment there is a possibility to view the photo of the sights, so you can see the place of its location, as well as the functionality of scanning a 2D object to display its history. Work on the development of a functional that makes it possible to recognize real-world objects to display information about them. Such a functional can be used, for example, for the reconstruction of partially lost objects of the cultural and historical heritage of the city. So, when you point the camera device on the destroyed column in Chersonese Tavricheskom, on the device will show how this column looked before, all this can be used to recreate buildings, streets and other.

It should be noticed that this requires the preliminary development of a 3D model of displayed objects, for which a laser 3D scanner is used. The scanned file is transmitted to the 3D modeler to eliminate the interference and bring the model to the desired view. In the case of historical objects that can not be scanned, the modeler develops the model data from scratch from archival imagery and other resources. The main platform of the developed application is smartphones running on the Android operating system.

In this way, the development of the potential of the region (city) correlates with the actualization of the resources of cultural and historical heritage (historical, cultural, architectural attractions, etc.). Digital technologies, actualizing the imagination of a person, make it possible to avoid monologic presentation of information, open the prospect of "immersion" in a particular historical era, that is, transfer the tourist from a passive viewer to a participant in a certain action.

The using of interactive technologies, in particular the technology of augmented reality, in the development of the historical and cultural potential of the region nowadays becomes a priority and allows us to

explore the spiritual experience of generations, is an important factor in maintaining identity, contributes to the formation of the region's attractiveness through the development of cultural tourism and the actualization of historical and cultural heritage.

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**Summary:** The article deals with issues related to the most significant aspects of the information and communication revolution. Social effects that correlate with the development of modern digital technologies are analyzed. The necessity to introduce interactive forms of "narration" for the development of the historical and cultural potential of the region is highlighted.

The author, considering the features of the integration of Sevastopol city into the sociocultural area of Russia, comes to the conclusion that in order to create an image attractiveness of the region for tourists and investors, it is necessary to update the historical and cultural potential. It is noted that this can be done only on the basis of the application of new methods and technologies, in particular, the technology of "augmented reality."

**Keywords:** historical and cultural potential, digital technologies, augmented reality, Russia, image of the region, Sevastopol.

UDC 004

### **THE IMPLEMENTATION OF A MEMORY MACHINE FOR MODELING THE BEHAVIOUR OF LIVING CREATURES.**

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Artificial intelligence is one of the newest sciences that appeared in the second half of the 20th century on the basis of computer technology,



If it is found, then there is the transition to the following state occurs (until the AI object catches up with the victim), and then the transition to the attack state. If an AI object that can be attacked is not found, the original AI object gets to the planned patrol point and goes back to the waiting state. The escape state is activated when the AI object has little health: in this case, the object selects a random point on the map and tries to reach it. In the event that the AI object's health is less than 0, it goes into a state of death.

The development of the prototype was carried out in the C # programming language and the engine for implementing interactive solutions Unity3d. A parent class was written for all AIs that defines common behavior, and the child classes for each of the AI object types. In the offspring classes, the behavior of each species was described.

In addition, to visualize the modeled world, the ability to display everything in augmented reality was added. To develop augmented reality, the Vuforia plug-in was used.

In a result of the work, a method for realizing artificial intelligence using a state machine was studied and a prototype application was developed to model the behavior of living beings.

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**Summary:** The relevance of creating artificial intelligence is associated with difficult problems which the humanity has to deal with. [1] It was developed a prototype that allows you to simulate the behavior of living creatures based on the state machine with memory.

**Keywords:** AI, artificial intelligence, state machine, programming, development, UNITY3D, C#.



## **SCIENTISTS HAVE CREATED BRAIN IMPLANTS THAT COULD BOOST OUR MEMORY BY UP TO 30**

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Since ancient times people tried to improve their physical abilities, for example to improve a vision, a hearing, walking and chewing when they had some problems accordingly. People used different kinds of things which could help them: magnifying lens, monocles, spectacles hearing-aids, even crutches and soon.

Later science suggested them artificial limbs, joints, crystalline lens, cardiostimulators and many other useful devices, so era of implants began. People could greatly improve their physical abilities, but a dream of improving memory was realized only with the help of medicine. However everybody would like to have a better memory, so that it is easier to prepare for exams or to memorize interesting facts, or simply telephone numbers.

Taking tablets one can improve memory, but they do not give a permanent effect and therefore require a lot of costs for prolonged use. They were replaced by a "brain prosthesis".

The researches at the University of Southern California have been developing brain implant for some years. This is an implant consisting of several electrodes that are implanted into the brain and imitate the natural neural processes of processing memories, acting by small electrical discharges to the hippocampus.

20 volunteers have already tested this implant. Each of them went through a simple game of memorization in which they were shown images. After 75 seconds they had to describe them. After that, the researchers analyzed the neutron response to determine the area of the brain responsible for the memories. In the next experiment, these regions were stimulated by microelectric discharges of the brain implant. As a result of the experiment it was proved that the device created increased memory by 30%.

In the future, this chip can be used by people with memory problems. This method surpasses the usual methods of improving memory by drugs.

For example, a brain prosthesis will not have age limitations, unlike most drugs, and it has a permanent effect and will not only help healthy people, but also patients with mental.

This disorders is proof that science in the medical field has moved far ahead. Now there are implants to improve the sound or return vision. They are also inserted into the brain and mimic the work of the sense organs replaced by them. Of course, these implants must be modified, but they already help to cure some diseases. Therefore, I believe that implantation is a very important step to achieve a society in which no one is limited by virtue of his illness.

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(дата обращения: 10.04.2018)

**Аннотация.** Статья касается одной из важных проблем, стоящих перед наукой – возможности улучшения памяти. Проведены некоторые испытательные тесты, в которых приняли участие 20 волонтеров с установленными имплантами. Установленные импланты могли увеличить возможности памяти более чем на 30% и могут быть полезны не только для здоровых людей, но и для людей, с расстройствами памяти.

**Ключевые слова:** Мозговая деятельность, электроды, импланты, усиление памяти.

**Summary.** The article concerns the most important problem – the problem of improving human being memory. There were some trial tests in with some 20 volunteers with set implants took part. Mental implants can boost performance on memory tests by up to 30% and can be useful not only for healthy people, but for people with memory disorders.

**Key words:** mental activity, electrodes, implants, memory boost.

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## **HUMAN BRAIN PROJECT**

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**Introduction.** The brain is like a universe in which crazy things happen, every moment. It is so mysterious, so incredible. It helps us to perceive what is around us. It helps us to learn new things.

**The main part.** “The Blue Brain mission is to build a detailed, realistic computer model of the human brain. And they have done, in the past four years. A proof of concept on a small part of the rodent brain, and with this proof of concept they are now scaling the project up to reach the human brain” [1, p. 126].

The neocortex is a part of the brain thought to be responsible for higher functions such as conscious one.

“The structure of the neocortex consists of several layers with a thickness of a credit card. The number of layers considered, determines the degree of development of thinking: for example, dogs have 4 layers and a man – 6. Vertically these layers are combined in a neural column of cortex.

This column was taken by the participants of the Blue Brain Project as a basis in the building of their models.

You can imagine the neocortex as a grand piano with a million keys. In addition, each of the columns of the neocortex plays some note. When you stimulate it you obtain a symphony. But it's not just a symphony of perception. It's a symphony of your universe, your reality” [1, p. 126].

Why are they doing this? There are three important reasons. They are:

- it's essential for us to understand the human brain if we do want to get along in society and I think that it is a key step in evolution;
- scientists cannot keep doing animal experimentation forever, and we have to embody all our data and all our knowledge into a working model;
- there are two billion people on the planet that are affected by mental disorder, and the drugs that are used today are largely empirical. I think that we can come up with very concrete solutions on how to treat disorders.

Main tasks to artificial consciousness are not necessary. How clever the participants of the Blue Brain Project noticed: “we can't exactly articulate what is consciousness, so it is difficult even to talk about the problem of its modeling”. They add: “the consciousness can be modeled by itself& [1].

There are no obstacles in principle to build a model of the cortex of the human brain. The development of algorithms of the model is quite likely seen the construction of a simulation of the entire cortex of the human brain within ten years. At last, everything depends on a suitable supercomputer, which could conduct the entire study.

Surely, blue Gene is the second supercomputer from IBM, the model

of the Blue Gene/P. If you decide to make themselves at home a virtual cat or hamsters, you will need a 415 teraflops supercomputer from IBM, which has 147 456 CPUs and 144 terabytes of RAM.

Also researchers from the Human Brain Project, along with colleagues from Intel, will jointly show three new neuromorphic chips during the NICE 2018 [2].

The new BrainScaleS-2 chip has been developed by researchers in the Human Brain Project. This chip is a mixed analog-digital design operating 1,000 – 10,000 times faster than real-time. The new chip features programmable on-chip learning capabilities and a new concept called dendritic computation developed in close collaboration with neuroscientists.

Sebastian Hoppner from TU Dresden will present a prototype of the new SpiNNaker-2 chip. This work is also supported by the Human Brain Project [3]. SpiNNaker-2 builds on the many-core architecture developed by Steve Furber from the University of Manchester. It will feature 144 ARM Cortex M4F cores on a single chip with a very advanced power management delivering a computational power of 36 billion instructions per second per Watt for a real-time simulation of complex neural networks [4, 5].

Neuromorphic chips mimic important aspects of biological brains like their energy efficiency, resilience and in particular their ability to learn. They promise to have a major impact on the future of artificial intelligence [6, 7].

So the next step is just to take these brain coordinates and to project them into perceptual space [8]. And if they do that, they will be able to step inside the reality that is created by this machine, by this piece of the brain. So they think that the universe evolved a brain to see itself, which may be a first step in becoming aware of it.

Hence you are at least partly convinced that it is not impossible to build a brain. I 'm sure that we will have such “super brain” to solve the global problems of humanity in the future.

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**Аннотация.** Описан Blue Brain Project – проект по компьютерному моделированию головного мозга человека. Проект использует суперкомпьютер Blue Gene для моделирования колонок. Отмечено, что продолжается работа над «режимом реального времени», при котором 1 секунда реального времени работы мозга моделируется процессорами за 1 секунду.

**Ключевые слова:** суперкомпьютер, сознание, неокортекс, голубой ген, Вселенная.

**Summary.** The Blue Brain mission is described. The neocortex as the part of the brain is considered. The author comes to the conclusion that the universe evolved a brain to see itself, which may be a first step in becoming aware of it.

**Keywords:** Blue Brain, supercomputer, consciousness, neocortex, Blue Gene, universe.

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## NEW ERA OF INTERNET

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Importance of internet in our life is similar to oxygen for this tech world. Today it's time about online reputation, internet marketing, online business, online degrees, social media presence and internet banking. That's why the importance of internet in our life matter.

The aim of the article is to discuss one of the newest tendency in Internet development, Web 3.0. The information about this new technology is very intricate and this work is the attempt to realize what it is and how it could change our life. There are three main aspects that have great influence on people's life. They are education, medicine and business. That's why the real and possible changes because of Web 3.0. will be highlighted in this article.

The Web's history presents three major stages: Web 1.0, Web 2.0 and Web 3.0.

The Web 1.0. wasn't given its name until it bit the dust. The "World Wide Web" as we call it now, was just a set of static websites with a load of information and no interactive content. The Web 1.0 presented data and information in a static way. It is characterized by low users' interaction with the content, for example, the users leave comments, manipulate or create content of a website. That generation of the Web was marked by the centralization of the content production. We used so many portals, AOL and directories, and Yahoo. The user was responsible for its own navigation and the identification of relevant content. She or he has a mostly passive role in a process.

Web 2.0 in contrast to Web 1.0 has its content mostly generated by its users in a process. Many users produce content and many consume the content. An example of this model is Wikipedia. Other examples of user-generated content platforms are in blogs, social networks and YouTube. The global sharing of information spawned the age of "Social Media". Youtube and Facebook gave voices to the voiceless and a means for like-minded communities to thrive. In Web 2.0 users are no longer just consumers. They become producers or co-producers of contents. In this version, search engines become more advanced and proliferate. There is no more room for lists of links in directories, which has given a huge volume of content [2].

Web 3.0 or Semantic Web combines the virtues of Web 1.0 and 2.0 by adding machine intelligence. In Web 3.0, the machines get along with users in content production and in decision-making, transforming traditional supportive role of the internet infrastructure to a protagonist entity in content or process generation. And one more thing, a lot of companies

invest in its own local networks. Facebook, Uber and AirBnB have created private networks for public infrastructure which they dominate[1].

Traditional tools used in Web 1.0 and 2.0 make search matching “word by word like” of the text in relation to what is published on the network. Often such a tool doesn't bring what is most relevant to the user at that time. Systems operating in the Web 3.0 standards, in turn, seek contextualized knowledge to assist people in their jobs. They point to series of analysis and potentially helpful information. One of the distinctions of Web 3.0 search engine, is the time that user need to spend sailing in a sea of information to find what he or she really wants to get solved[3].

So, there is no clear and unique explanation. In 2006, Tim Berners Lee said, “People keep asking what Web 3.0 is. I think maybe when you’ve got an overlay of scalable vector graphics – everything rippling and folding and looking misty – on Web 2.0 and access to a semantic Web integrated across a huge space of data, you’ll have access to an unbelievable data resource...”[4].

The following five features can help us define what it is Web 3.0:

1. Semantic Web,
2. Artificial Intelligence,
3. 3D Graphics,
4. Connectivity,
5. Ubiquity.

The next evolution of the Web involves the semantic web that improves web technologies in order to generate, share and connect content through search and analysis based on the ability to understand the meaning of words, rather than on keywords or numbers.

Combining this capability with natural language processing, in Web 3.0, computers can understand information like humans in order to provide faster and more relevant results. They become more intelligent to satisfy the needs of users.

The three dimensional design is being used extensively in websites and services in Web 3.0. Museum guides, computer games, ecommerce, geospatial contexts, etc. are all examples that use 3D graphics.

With Web 3.0, information is more connected thanks to semantic metadata. As a result, the user experience evolves to another level of connectivity that leverages all the available information.

Content is accessible by multiple applications, every device is connected to the web, the services can be used everywhere, so called ubiquity.

These features bring us closer to a Web 3.0 definition, but doesn't make it somewhat definite. For the most part, it's already a reality today, for

example, the semantic web and artificial intelligence. Others are not so real for all users, but people as consumers and producers of the content can use this or that feature of Web 3.0. in different life aspects, such as education, medicine and business.

The world of education is the most powerful and flexible aspect of our life. All of us use Internet in our everyday life to learn something, even if we don't speak about a university degree. The first is the development of a semantic web. Computers are not good at contextualizing. But there's no reason they couldn't be. If we use Web 2.0. tools, we search for a word or category. But if Web 3.0. gave us a new feature, we could search with a computer in a way that we would have a conversation with another human. Imagine a human with the computational capacity of all of the networked computers in the world[3].

The second part is where semantic intelligent computing interacts with the physical world. We see that in technology today. Google Goggles allows you to scan the physical world and do instant visual analysis against everything on the web. Maybe in the nearest future people get everything from eyewear that allows for digital connection to smart clothing that tracks a patient's heart rate or blood pressure.

That leads to the third part, which is the alteration of physical space itself. Anything that has a transistor in it, that plugs in, that uses Wi-Fi all of a sudden becomes a data access point. Another is finding more time for interaction. We need to shift education from a focus on consumption of content provided by the teachers to creation by the students. You will have access to information about how to do things, education is much more project-based, much more just-in-time learning.

Web 3.0 is likely to have a big effect on medicine. In bioinformatics, it will become more common to process ever larger amounts of data. In fact, experts in bioinformatics already search for data from disparate systems, and they have started to build rich semantic relations into information tools for knowledge discovery. Finally, greater capacity for creating knowledge in medicine will be possible if we have the will to publish clinical data openly and transparently, and subject it to scrutiny[4].

Developing a more personalized healthcare system will be an important challenge for doctors in web 3.0. In an era of greater personalization, treating patients' health problems according to their genetic profiles will depend on using the latest information technologies. Even the treatment of new diseases and warning systems for natural disasters will benefit from the merging of epidemiological datasets with virtual, three dimensional tools like Google Earth. Making the search for health



information efficient and responsive to patients' needs will also help reduce the costs of medical treatment.

For now semantic web technology can be one of the key differentiators of the business. Currently in most cases standard IT systems are available for every company on the market at reasonable price or even free of charge, we call it open source. Therefore, semantic web applications that are not yet so popular can be the special strategic differentiator that the company brings to the market.

The new search engine called Polaris uses public data on the Web, proprietary data, and social media, to identify interesting entities and relationships and add them to the knowledge base called Social Genome. The Social Genome is a tool that helps Walmart reach their customers by semantic analysis of real time social media streams. The semantic capabilities of the Walmart's store are developed on the basis of a social media technology platform that filters and organizes content in social networks such as Pinterest, Facebook, Twitter and Google+ to get relevant information on the users' interests. The semantic search engine uses natural language processing for understanding user's query and base of synonyms to figure out the user's intent and render the best possible results. For example if a user types in the keyword "denim," he gets search results on "jeans" also, while typing-in "chlorine tablets" the search engine returns results related to pool equipment, according to examples provided by the company. Also a banner is displayed with featured items on sale, to help shoppers discover items they may have not considered. After implementing the new search engine, over the last few months, Walmart had already seen about 10 to 15 percent increase in shoppers that complete a purchase after searching for a product using Polaris[5].

Conclusion. We are living in an interesting time in history, where the Web begins to bring more knowledge and action capacity for its users, resulting in considerable changes in several aspects of daily life. This new Web is moving fast towards a more dynamic environment, where the democratization of the capacity of action and knowledge can speed up business in almost all areas, ranging from: retail to applied molecular medicine; from micro-businesses to large corporations.

Just as the Web 2.0 didn't automatically extinguish Web 1.0., the move to Web 3.0 will take time and integration with existing online systems. Web 3.0 is an revolution in motion. And we are the participants and some of us are the creators. It doesn't matter whether a person is computer-literate or not he or she can move the new technology and make his or her contribution to the internet development.

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**Аннотация.** Целью данной работы является обсуждение Web 3.0. Фокус сделан на пять основных характеристик новой технологии. История развития веб-технологии представлена. Некоторые характеристики Web 3.0 объяснены более детально. Данная статья также обсуждает возможное влияние на нашу жизнь, в основном, в таких жизненных аспектах, как образование, медицина и бизнес. Показаны также сложные вопросы, которые могут замедлить или ускорить развитие этой новой технологии.

**Ключевые слова:** Веб, интеллект, содержание (контент), пользователь, развитие.

**Summary.** The aim of this work is to discuss Web 3.0. The focus on main features of new technology is made. The history of web development is revealed. Some features of Web 3.0 are explained in details. This article discusses the possible influence on our life, mainly in such life aspects as education, medicine and business. It also shows some complicated issues that can slow or speed up the development of this new technology.

**Key words:** Web, intelligence, content, user, development

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## NEUROCHAT AS MEANS OF COMMUNICATION

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Communication is an integral part of human life. Our relationships with surrounding people depend on our ability to communicate. Communication itself is the process of sending and receiving messages through verbal and nonverbal means including speech or oral communication at least. However, not all people have the opportunity to this complex process of interaction with others. For those persons who experience some difficulties no matter whether the psychological or emotional issues other health problems.

The article deals with the attempt of the scientists to solve this problem or, though, to get the approach to it. If disabled people have an opportunity to communicate, their circle of communication will not be so limited; as it is. Negative influence of their solitary life that could affect their inner mental state would be eliminated. The actuality of my paper is to sum up all the steps of one of the most prospective in this sphere projects.

Fast-moving technological development, advances in neuro-sciences and development in artificial intelligence of the latest decade have made the first transcontinental contact between patients deprived of speech and movements possible based on neuro-interfaces. This is not only demonstration of the latest neuro-communication technologies, but also a unique borderless opportunity for co-operation between researchers, developers and entrepreneurs of Russia and other countries [3].

Russian scientists are introducing revolutionary technology that will allow talking to those who still could not because of a serious illness. The Neurochat project is more than ten years of research by MSU scientists and the development of Russian companies. It is a hardware and software complex that includes a neuro-headset GarAnt-EEG and a special interface ErgoStim, which implemented on user's computer. With each new prototype, the device has become easier and more convenient. In Taganrog, a unique miniature signal amplifier was developed, the headset itself is wireless. Many patients who need this technology do not move, so nothing should interfere. Russian scientists are developing cutting-edge communication technology to help fully paralyzed people communicate, as well as use social networks and even work [1].

In the Neurochat the scientists use a neuro-headset, put it on the patient head. It is, in fact, a mini electroencephalograph removes the activity of the brain-cortex. Through a wireless headset the "mental intention" is

transferred to a computer via Bluetooth. People have the possibility to express their thoughts both with letters and with symbols. Symbols and letters highlighted in a certain way are displayed on the monitor. The patient reads them with the power of the brain. The device records changes in bioelectroactivity and identifies the letters that the patient wants to communicate. Then, they add up sentences on the monitor. For example, with the help of a symbol one can say, "I feel pain," "I want to eat," and "I'm happy," while words and sentences can be formed with letters. In early 2017 NeuroChat specialists tested the development on ten paralyzed patients. A user's attention can be distracted because of his condition and his psychological weariness can influence the result, which is why the technology is only 95-percent accurate. [2].

The whole Neurochat system consists of several components: a hardware-software system, a wireless neuro-headset and special software. The person concentrates on a certain letter of the alphabetic matrix, which can be represented on the screen or keyboard. The technology works with the reliability of successful attempts to "click" on a conceived symbol equal to 95% on average for ordinary objects. The time for performing the mental choice depends on the number of objects on the screen (for 12 objects - 2-3 seconds). Then the reading facilities read the information to the computer. Thus, it is possible to "type" any messages of unlimited length in any text editor or instant messenger.

Previously, people tried to communicate with the outside world by typing with a stylus attached to the head, or flashing when the mother pronounces the desired letter. Neurochat can save time and effort. It is easy to operate; the learning takes only 12 minutes. The algorithm for determining mental commands is developed taking into account possible low characteristics of the user's attention, motivational and emotional settings and taking into account increased mental fatigue. He or she begins to look at the letter, think about it, and it is printed. Everything on the screen is written only by the power of thought. There is a system similar to T9 as in smartphones here - it is suggested to write a word or phrase all at once.

The translator is integrated into the system. Accordingly, even without knowing the language, patients can communicate with each other, pushing the boundaries of their not only physical capabilities, but also geography.

Neurochat was one of the first projects that received public investment under the Russian program "National Technological Initiative" [1].

In January 2018, Neurochat was presented at one of the largest medical exhibitions in Las Vegas. Scientists around the world are trying to find a practical use of the power of thought. However, "materialize the idea" has not yet been achieved. Russian Neurochat is the only development in

the world with practical application. And already this year they plan to produce 500 sets of equipment for use in rehabilitation centers and hospitals.

Recently, the world's first transcontinental session of neural communication took place. Patients from Russia and the United States, unable to speak and move independently exchanged messages in the Neurochat. The text was printed without the help of hands and voice, solely by the power of thought.

In the near future, the first 500 devices will be delivered to patients in Russia, and free of charge. To get a neuro-headset, you just need to leave an application on the developer's site. The price would start at \$100, and it will also be possible to rent the device.

Neurochat will give paralyzed people a chance to remain active professionally in programming, translation and literature. This project developers believe their technology will help paralyzed people gain access to social networks and email - write messages, send material, and use apps. Moreover, patients from various countries will be able to communicate with each other since the project contains a built-in translation service.

"We've been working for 10 years, dealing with several thousand people with heavy motor and speech disorders," said Ruslan Kurbanov, director of social service at the Preodolenie Rehabilitation Center. "In general, patients use the computer and the telephone with their voices, their noses and even their tongues. Thanks to technologies such as NeuroChat people with spinal disorders and paralysis can again become socially active." [1]

In December 2016 the first practical test of new neuro-headsets was successfully carried out. In January 2018 the first international presentation was made during the largest exhibition of personal electronic appliances (CES 2018). In February 2018 the communication between the postinsult (post-stroke) patients were carried out with the help of this new technology in the cooperation of the Moscow and Los Angeles hospitals.

Conclusion. Scientists and experts are working on the social media platform Neurochat that would allow people to use it without hands. Given that cognitive functions remain in place, people with physical disabilities and impaired verbal capabilities want to communicate with the world and each other just as everyone else. That was the main goal for developing such a program. Using the power of their brains people with the help of new technology would be able to type texts/ and they would do it without moving or speaking. The special device converts brain impulses into specific commands.

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**Аннотация.** Целью данной работы - представить обзор самого нового проекта в IT сфере, о Нейрочате. Основное внимание сфокусировано на двух аспектах данного проекта: стадии его внедрения и технические характеристики новой технологии. Анализ информации из интернет-источников показал, что этот проект является самым перспективным в двух сферах: в сфере информационных технологий и в сфере медицины. Преимущества нейрочата обсуждены в статье. Подчеркнуто важное значение программы, позволяющей производить общение без движения рук и задействования органов говорения.

**Ключевые слова.** нейрочат, общение, инвалидность, сотрудничество, программирование

**Summary.** The aim of this work is to review the very new project in the IT sphere, about Neurochat. The focus is on two main things of this project, the steps of its application and the technical peculiarities of this technology. The web-site information reveals that it is the most prospective project in two spheres, in IT and medicine. The advantages of the Neurochat are discussed in this article. The significance of program that allows to develop the communication without moving hands or speaking is stated.

**Keywords.** Neurochat, communication, disabilities, cooperation, programming

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## CLOUD COMPUTING

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Cloud computing model provides convenient network access on demand to a common fund of configurable computing resources (e.g., data networks, servers, storage devices, applications and services – either together or separately), which may be provided and operatively released with minimal operating costs or appeals to the provider [3].

The essence of the concept of cloud computing is to provide end users with remote dynamic access to computing resources and applications (including operating systems and infrastructure) through the Internet. Development Hosting sphere was due to the need arose in the software and digital services, which could be controlled from the inside, but which would be at the same time more economical and efficient due to economies of scale.

The word "cloud" was used in the 1990s to refer to the metaphorical Internet: if the Global Network is something mysterious, uncertain in its spatial boundaries indistinguishable from its internal elements and fast-paced.

At the beginning of the XXI century the term "cloud computing" began to be used in relation to the direction arisen with SaaS (Software as a Service) [4]. A pioneer in this respect was the online store Amazon, which moved its data centers on Open Source. 90% of the servers of the company began to work on the basis of Red Hat Linux operating system (with the application Stronghold Web Server, one of the Apache build options).

They represented the service that five years later became known as the "cloud" – a set of services on remote servers to which the user can access through a web browser from any location where there is Internet.

In 2007, several American universities have joined a similar project (Academic Cluster Computing Initiative), which took part Google and IBM. For them, these companies build data centers for 1,600 servers and equipped them with the appropriate software for the management and implementation of remote access to computing resources.

Also in the race for the "clouds" came Yahoo!, Microsoft and eBay, and in 2008 the computer industry has already met under the "cloud": analysts touted a new optimization strategy costs by eliminating the high-performance computers to Internet services like "the Google Documents".

#### Types of Clouds

Since the "clouds" – the notion of a collective, it makes sense to classify them according to some criterion. There are two classifications of "clouds", one of which was suggested by the InfoWorld magazine, and the

other – by trade Director of Parallels, one of the market leaders in virtualization.

InfoWorld analysts propose to divide all the "clouds" into seven types:

- SAAS (Software as a Service) – direct applications (for example, Zoho Office or Google Apps) [4].

- TOOLS AND CALCULATIONS – for example, virtual servers.

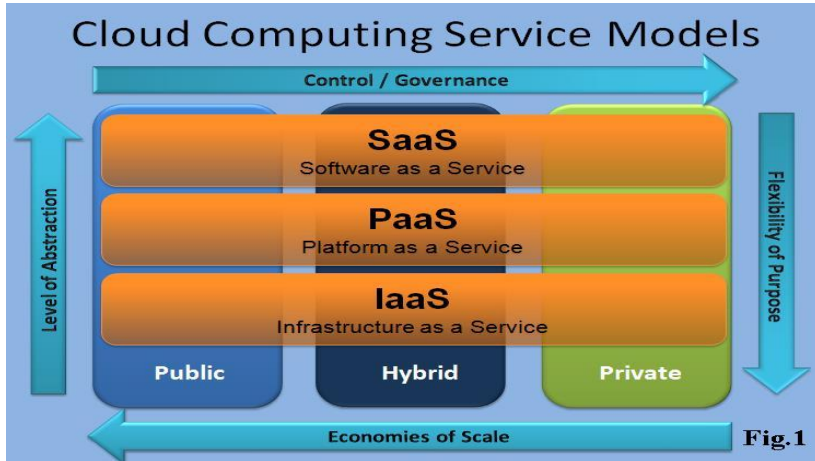
- Web services in the "cloud" – optimized for virtual environments online services (e.g. Internet banking).

- PAAS – «Platform as a Service", that is a new generation of web applications that allows to build a range of options by the user (such as Live Mesh from Microsoft).

- MSP – Provider of Managed Services (Managed Service Provider), catering service providers (e.g. built-in anti-virus scanners for mail portals).

- Commercial platform for services – association PaaS and MSP (e.g., Cisco WebEx Connect).

A cloud can be public or private (Fig.1). Public cloud services can be used by anyone. At the moment, Amazon Web Services – is the most famous and largest provider providing services in the public cloud. The main difference between private clouds and the public ones is the provision of a service from the cloud in a closed form to the shared infrastructure of a limited number of users.



There is another definition of "virtual private cloud", namely, when the provider uses public cloud infrastructure as the private cloud. With this organizational structure, part of customer data are stored, processed by the resources of their own infrastructure, and the part due to an external resource provider [3].



As an example, the virtual private cloud can lead the company Amazon service called Amazon Virtual Private Cloud (Amazon VPC).

The Amazon Virtual Private Cloud Advantages:

- It has access to their data anywhere there is Internet access.
- Many services offer a certain amount of memory.
- Good data protection.
- Saves space on your hard disk, which increases the speed of reading data from the hard disk.

Disadvantages:

- There is a possibility of theft of data during transmission.
- Depending on the service provider it may also result in data leakage.

In conclusion, it should be said that at the moment there is an active development and improvement of cloud computing. But we are talking about development, rather than the use. At the moment, it is a lot to be afraid of the fact that the information will keep people from outside. Although the near impossibility of loss or theft of data has already been proved, not many users are willing to trust such a service. Now it is also affected by the lack of the quality, stability and speed of Internet connections, which creates tangible difficulties for developers.

However, despite these significant shortcomings, advantages from the introduction of this technology are clear to everybody. It's benefits for consumers are: the fight against piracy for developers to minimize the costs in the IT field for business, standardization of network standards for all users.

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**Аннотация.** Статья посвящена передоай и быстро развивающейся технологии облачных вычислений, которые на сегодняшний день имеют множество определений и названий. Поддержка облачных вычислений в сочетании с инвестициями в молодые компании создают быстро развивающуюся экосистему

инновационных производств. Целью статьи является анализ технологии реализации облачных вычислений. Авторы также рассматривают рассмотреть ряд преимуществ и выгодных сторон этой передовой компьютерной технологии.

**Ключевые слова.** Облако, облачные вычисления, облачное хранилище, виртуальный сервис, приватное хранилище, приватное облако, виртуальная среда, сеть, облачная инфраструктура, технология вычислений, провайдер, приложения, Интернет.

**Summary.** The article is devoted to advanced and constantly developing technology of Cloud Computing having a lot of definitions and names nowadays. Support for cloud computing, combined with investments in young companies creates a rapidly evolving ecosystem of innovative industries. The purpose of the article is to analyze the technology for implementing cloud computing. The authors also consider a range of advantages and benefits resulting from this advanced computer technology.

**Keywords.** Cloud, cloud computing, cloud storage, virtual service, private storage, private cloud, virtual environment, cloud infrastructure, network, computing technology, provider, applications, Internet.

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## THE PROBLEM OF PROTECTING INFORMATION IN THE INTERNET

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To date, few people can imagine their lives without the Internet. Thanks to the worldwide global network, people conduct various financial transactions, buy goods and services, make payments and perform many other actions that require compliance with confidentiality and protection. The rapid growth of the Internet, along with a significant number of new opportunities and services, brought a number of new challenges. One of the most common problems is the problem of information security [4, p.183].

On forums or in social networks, you can find many stories telling about how sophisticated methods hackers can penetrate into other people's computers. The mere thought that any attacker could gain access to the archives of the company forces management to abandon the use of open information networks.

However, experts argue that companies with access to private networks can also become victims of ill-wishers.

But what can happen with the information, if you do not care about its security? Your personal information may remain unchanged, but its confidentiality will be compromised. For example, your bank card number will be publicly available and anyone can use it. The information can be changed. Someone can re-arrange your order in the online store or change the details of your resume. Information can be replaced. This problem occurs when the server tries to impersonate another, which it is not [1, p. 17].

But to know how to protect information, you need to have an idea of how your computer can be attacked. The attack can be done from the server side. In this case, a hacker who has his own server can, with the help of JavaScript applications that are embedded in an HTML document, disable the user system or access it.

Attack on the server from the client side. Using security gaps in CGI applications, poor server configuration, or CGI application substitution, an experienced programmer accesses an earlier inaccessible server. Information can be withdrawn by a third party when it is transferred. During the interaction between the client and the server, someone is able to intercept the information you transmit using special programs or scripts [2, p. 10].

In order to avoid an attack on the computer, you must carefully monitor which domains the site uses, which prompts you to enter the server. Modern versions of browsers are equipped with built-in hazard indicators. Some people display a message about the suspicious content of the site, others warn that the entered data can be intercepted by intruders.

Usually, when a threat is detected, we strive to hide valuable documents and files on our device in inaccessible place and provide them

with protection. This method is convenient for data that the user rarely uses. But if a file is often accessed, its search takes time and causes inconvenience. This is the security dilemma: you have to choose between the security of your data and its availability to you. [3, p.68]

In the field of information, the security dilemma is formulated as follows: one should choose between the security of the system and its openness. It is more correct to talk not about choice, but about balance, since a system that does not possess the property of openness can not be used.

This problem is relevant to this day, since no one can fully guarantee that your data will be protected. Many scientists in the field of information technology conduct research in order to protect as much as possible the personal information of users from intruders. Thanks to these studies, ways of protecting information, such as access delineation, password protection, data encryption, were developed. However, until now we can hear that hackers hacked the server or committed attacks on computer systems. This indicates that this problem has not been solved yet and sufficient time and effort will be allocated to its solution.

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**Аннотация.** Статья посвящена проблеме и способам защиты информации в сети Интернет. Авторы повествуют о том, что может произойти с незащищённой информацией и описывают основные методы проникновения в компьютерную систему неавторизованных пользователей, раскрывая значение термина «безопасность». В целом, статья призывает к осторожному использованию вебсайтов и преднамеренному предоставлению персональных данных.

**Ключевые слова.** Интернет, информация, безопасность, личные данные, вебсайт, защита информации, конфигурация сервера, клиент, хакерское вторжение, атака, браузер.

**Summary.** The article is devoted to the problem of information

protection in the Internet and ways to solve it. The authors tell about what can happen with the information if it is not protected, and mention the main methods of attacking the computer by intruders, highlighting the meaning of the term "security". As a whole the article calls for careful use of websites and deliberate introduction of personal data.

**Keywords.** Internet, information security, personal data, protection, website, server configuration, client, threats detecting, hacker attack, browser.

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## **MEASURING TRANSDUCER BASED ON A WAVEGUIDE TEE-BAND**

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### **1. Introduction.**

Measuring transducers based on waveguide tee are widely used due to the relative ease of implementation of these elements. At the same time, this type of polar explorers also has significant disadvantages, which prevent the achievement of high accuracy in the measurement of the reflection coefficient module. Insufficient electrical isolation between the shoulders of the tee and the complexity of their coordination are the reasons for the low accuracy of measurement at the moment. Increasing the interchange and the degree of harmonization requires stricter requirements for the quality of manufacture of the eight-pole, so the further increase in the accuracy of measurement should be carried out by structural methods of correction of measurement error.

### **2. Exploring the possibilities of the analytical method**

Exploring the possibilities of the analytical method

We will conduct a study of the possibilities of the analytical correction error method, due to the nonidentity elements of the scatterplot matrix, the ultimate results and imperfection of coordination of the elements of the microwave circuit of the meter.

On the figure 2.1 a generalized block diagram of a measuring transducer based on an eight-pole is shown.

In this figure, through the  $\Gamma_g$ ,  $\Gamma_d$ ,  $\Gamma_x$ ,  $\Gamma_e$  the complex reflection coefficients (CRC) generator, power sensor, the tested and the reference loads are designated.

We determine the dependence of the output signal of the power sensor in the  $i$ - state of the reference load. To do this, we use the well-known relationship of incident and reflected waves at the eight poles.

$$\begin{cases} b_1 = S_{11}a_1 + S_{12}a_2 + S_{13}a_3 + S_{14}a_4 ; \\ b_2 = S_{21}a_1 + S_{22}a_2 + S_{23}a_3 + S_{24}a_4 ; \\ b_3 = S_{31}a_1 + S_{32}a_2 + S_{33}a_3 + S_{34}a_4 ; \\ b_4 = S_{41}a_1 + S_{42}a_2 + S_{43}a_3 + S_{44}a_4 . \end{cases} \quad (2.1)$$

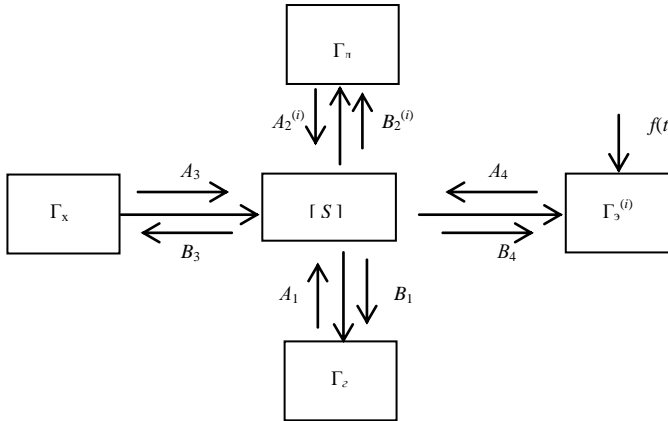


Figure 2.1 – The scheme of the transmitter

The boundary conditions at the eight poles are written as follows

$$\begin{cases} a_1 = E_e + b_1 \Gamma_e ; \\ a_2 = b_2 \Gamma_\pi ; \\ a_3 = b_3 \Gamma_x ; \\ a_4 = b_4 \Gamma_{3(i)} . \end{cases} \quad (2.2)$$

Substituting (2.2) into a system of equations (2.1), we convert it to form

$$\begin{cases} -S_{11}E_{\varepsilon} = b_1 (S_{11}\Gamma_{\varepsilon} - 1) + b_2 S_{12}\Gamma_{\text{д}} + b_3 S_{13}\Gamma_{\text{x}} + b_4 S_{14}\Gamma_{\text{э}} ; \\ -S_{21}E_{\varepsilon} = b_1 S_{21}\Gamma_{\varepsilon} + b_2 (S_{22}\Gamma_{\text{д}} - 1) + b_3 S_{23}\Gamma_{\text{x}} + b_4 S_{24}\Gamma_{\text{э}} ; \\ -S_{31}E_{\varepsilon} = b_1 S_{31}\Gamma_{\varepsilon} + b_2 S_{32}\Gamma_{\text{д}} + b_3 (S_{33}\Gamma_{\text{x}} - 1) + b_4 S_{34}\Gamma_{\text{э}} ; \\ -S_{41}E_{\varepsilon} = b_1 S_{41}\Gamma_{\varepsilon} + b_2 S_{42}\Gamma_{\text{д}} + b_3 S_{43}\Gamma_{\text{x}} + b_4 (S_{44}\Gamma_{\text{э}} - 1). \end{cases} \quad (2.3)$$

The solution of the system of equations (2.3) with respect to the wave incident on the sensor power DM, has the form

$$b_2 = \frac{E_{\varepsilon} S_{21} (1 - S_{33}\Gamma_{\text{x}} - S_{44}\Gamma_{\text{э}} - \Gamma_{\text{x}}\Gamma_{\text{э}}S_{34} + \Gamma_{\text{x}}\Gamma_{\text{э}}S_{33}S_{44}) + \Gamma_{\text{э}}S_{24}S_{41} (1 - S_{33}\Gamma_{\text{x}}) + \Gamma_{\text{x}}S_{23}S_{31} (1 - S_{44}\Gamma_{\text{э}})}{N}$$

,где

$$N = 1 - S_{11}\Gamma_{\Gamma} - S_{22}\Gamma_{\text{д}} - S_{33}\Gamma_{\text{x}} - S_{44}\Gamma_{\text{э}} - S_{21}^2\Gamma_{\text{д}}\Gamma_{\Gamma} - S_{31}^2\Gamma_{\Gamma}\Gamma_{\text{x}} - S_{41}^2\Gamma_{\Gamma}\Gamma_{\text{э}} - S_{23}^2\Gamma_{\text{д}}\Gamma_{\text{x}} - S_{24}^2\Gamma_{\text{д}}\Gamma_{\text{э}} - S_{34}^2\Gamma_{\text{x}}\Gamma_{\text{э}} +$$

$$+ S_{11}\Gamma_{\Gamma}\Gamma_{\text{э}}S_{44} + S_{11}\Gamma_{\Gamma}\Gamma_{\text{д}}S_{22} + S_{11}\Gamma_{\Gamma}\Gamma_{\text{x}}S_{33} + S_{22}\Gamma_{\text{э}}\Gamma_{\text{д}}S_{44} + S_{22}\Gamma_{\text{д}}\Gamma_{\text{x}}S_{33} + S_{33}\Gamma_{\text{x}}\Gamma_{\text{э}}S_{44}.$$

As a result of transformations, the expression (2.3) is

$$b_2 = \frac{E_{\Gamma} S_{21} (1 - A_1\Gamma_{\text{x}} - A_2\Gamma_{\text{э}} - A_3\Gamma_{\text{x}}\Gamma_{\text{э}})}{1 - A_4 - A_5\Gamma_{\text{x}} - A_6\Gamma_{\text{э}} + A_7\Gamma_{\text{x}}\Gamma_{\text{э}}}, \quad (2.4)$$

where

$$A_1 = S_{33} - \frac{S_{23}S_{31}}{S_{21}}; \quad A_2 = -S_{44} + \frac{S_{24}S_{41}}{S_{21}};$$

$$A_3 = S_{34}^2 + S_{33}S_{44} - \frac{S_{24}S_{41}S_{33}}{S_{21}} - \frac{S_{23}S_{31}S_{44}}{S_{21}};$$

$$A_4 = S_{11}\Gamma_{\Gamma} - S_{22}\Gamma_{\text{д}} - S_{21}^2\Gamma_{\text{д}}\Gamma_{\Gamma} + S_{11}\Gamma_{\text{д}}\Gamma_{\Gamma}S_{22};$$

$$A_5 = -S_{33} - S_{31}^2\Gamma_{\Gamma} - S_{23}^2\Gamma_{\text{д}} + S_{11}\Gamma_{\Gamma}S_{33} + S_{22}\Gamma_{\text{д}}S_{33};$$

$$A_6 = -S_{44} - S_{41}^2\Gamma_{\Gamma} - S_{24}^2\Gamma_{\text{д}} + S_{11}\Gamma_{\Gamma}S_{44} + S_{22}\Gamma_{\text{д}}S_{44};$$

$$A_7 = S_{33}S_{44}.$$

Thus, for the voltage at the output of the quadratic detector, we obtain

$$U_2 = K_{\text{д}} |b_2|^2 = K_{\text{д}} E_{\Gamma}^2 \left| \frac{S_{21} (1 - A_1\Gamma_{\text{x}} - A_2\Gamma_{\text{э}} - A_3\Gamma_{\text{x}}\Gamma_{\text{э}})}{1 - A_4 - A_5\Gamma_{\text{x}} - A_6\Gamma_{\text{э}} + A_7\Gamma_{\text{x}}\Gamma_{\text{э}}} \right|^2, \quad (2.5)$$

where  $K_{\text{д}}$  —the conversion factor of the microwave detector.

The expression (2.5) is a nonlinear equation linking the voltage of microwave detector with complex coefficients of reflection, the study of a dipole, the reference loads and generalized constants. Moreover, it changes in advance by phase and is determined by known methods. Therefore, the number of stationary standing meter can be set based on the conditions

$$i \geq m,$$

where  $i$  — the number of values of the phase shift  $\alpha_i$  complex reflection coefficient of the reference load;  $m$  — number of unknowns.

Based on these considerations, we obtain a system of equations

$$U_2^i = K_{\text{д}} |b_2^i|^2 = K_{\text{д}} E_{\Gamma}^2 \left| \frac{S_{21}(1 - A_1 \Gamma_X - A_2 \Gamma_{\text{э}i} - A_3 \Gamma_X \Gamma_{\text{э}i})}{1 - A_4 - A_5 \Gamma_X - A_6 \Gamma_{\text{э}i} + A_7 \Gamma_X \Gamma_{\text{э}i}} \right|^2, \quad (2.6)$$

which can be resolved relatively unknown.

It is obvious that the exact solution of the system (2.6) requires large computational expenses, justified in accurate cost measurements.

Ignoring the terms of the second and higher orders of smallness in formulas (2.1)...(2.6), we obtain approximate expressions for the calibration constants

$A_1 = S_{33} - \frac{S_{23}S_{31}}{S_{21}}$	(2.7)
$A_2 = -S_{44} + \frac{S_{24}S_{41}}{S_{21}}$	(2.8)
$A_3 = -\frac{S_{24}S_{41}S_{33}}{S_{21}} - \frac{S_{23}S_{31}S_{44}}{S_{21}}$	(2.9)
$A_4 = S_{11}\Gamma_{\Gamma} - S_{22}\Gamma_{\text{д}}$	(2.10)
$A_5 = -S_{33} - S_{31}^2\Gamma_{\Gamma} - S_{23}^2\Gamma_{\text{д}}$	(2.11)
$A_6 = -S_{44} - S_{41}^2\Gamma_{\Gamma} - S_{24}^2\Gamma_{\text{д}}$	(2.12)
$A_7 = 0$	(2.13)

Taking into consideration (2.7)...(2.13) we'll get

$$U_2^i = K_{\text{д}} |b_2^i|^2 = K_{\text{д}} E_{\Gamma}^2 \left| \frac{S_{21}(1 - A_1 \Gamma_X - A_2 \Gamma_{\text{э}i} - A_3 \Gamma_X \Gamma_{\text{э}i})}{1 - A_4 - A_5 \Gamma_X - A_6 \Gamma_{\text{э}i}} \right|^2. \quad (2.14)$$



In the case of small misalignments of the shoulders of the eight-pole (when  $S_{11} = S_{22} = S_{33} = S_{44} = 0$ ) calibration constants the expression will be:

$A_1 = -\frac{S_{23}S_{31}}{S_{21}}$	(2.15)
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$A_2 = \frac{S_{24}S_{41}}{S_{21}}$	(2.16)
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$A_3 = 0$	(2.17)
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$A_4 = 0$	(2.18)
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$A_5 = -S_{31}^2\Gamma_{\Gamma} - S_{23}^2\Gamma_{\Delta}$	(2.19)
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$A_6 = -S_{41}^2\Gamma_{\Gamma} - S_{24}^2\Gamma_{\Delta}$	(2.20)
--	--------

$A_7 = 0$	(2.21)
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Taking into consideration (2.16) (2.21) we'll get system of equations for the simplified model.

$$U_2^i = K_{\Delta} |b_2^i|^2 = K_{\Delta} E_{\Gamma}^2 \left| \frac{S_{21}(1 - A_1\Gamma_x - A_2\Gamma_{\Delta i})}{1 - A_5\Gamma_x - A_6\Gamma_{\Delta i}} \right|^2 \quad (2.22)$$

### Conclusion

Given system of equations for a simplified model of eight pole on the basis of a double waveguide tee is obtained. The equations of the system contain measuring information about the proper parameters of the microwave path of the meter and the characteristics of the studied bipolar. The solution of the system of equations can significantly reduce the measurement error by taking into account the nonideality of the characteristics of microwave parameters of the measuring path.

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**Аннотация.** Измерительные преобразователи на основе волноводного тройника имеют широкое применение в силу относительной простоты реализации этих элементов. Однако

восьмиполюсники такого типа имеют и существенные недостатки, препятствующие достижению высокой точности измерения коэффициента отражения. Дальнейшее снижение точности измерения с помощью рассматриваемого преобразователя целесообразно осуществлять методами коррекции погрешности измерения. Полученные выражения дают при этом возможность учесть асимметрию плеч двойного тройника по амплитудно-частотным и фазо-частотным характеристикам и, таким образом повысить точность измерения.

**Ключевые слова:** измерительный преобразователь, коэффициент отражения, аналитический метод коррекции, система уравнений, погрешность измерения, двойной волноводный тройник, амплитудно-частотные характеристики, фазо-частотные характеристики.

**Summary.** Measuring transducers based on waveguide tee are widely used due to the relative simplicity of the implementation of these elements. However, eight poles of this type also have significant disadvantages that prevent achieving high accuracy of reflection coefficient measurement. A further reduction of measurement accuracy by means of the considered converter, it is advisable to implement by means of methods of error measurement correcting. The obtained expressions give the opportunity to take into account the asymmetry of the shoulders of the double tee in amplitude-frequency and phase-frequency characteristics and thus improve the accuracy of measurement.

**Keywords:** measuring transducer, reflection coefficient, analytical method of correction, system of equations, measurement error, double waveguide tee, amplitude-frequency characteristics, phase-frequency characteristics.

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## ANALYSIS OF BALANCE BRIDGE OPERATION ON THE BASIS OF DUAL WAVEGUIDE TEE

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## **1. Introduction**

Balance Microwave bridge is one of the most accurate devices used to measure the reflectance (total resistance) of microwave [1]. double waveguide tees used are usually as such bridges, having a relatively wide range of operating frequencies, determined by the band, within which there is a good agreement of the node on the part of the shoulders H and E, and when the  $SWR < 1,1$  reaching more than

15% of the average frequency at which the matching was performed. The main disadvantage of the double tee is the asymmetry of its amplitude-frequency and phase-frequency characteristics of the shoulders, which leads to a significant decrease in the accuracy of measurement.

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## **2. Analysis of the balance bridge**

When measuring the reflection coefficient of the bipolar, the test device is connected to one of the lateral arms of the bridge, for example, to the shoulder (3), the agreed double tee shown in Fig. 2.1.

To the other arm of the bridge (4) an exemplary variable calibrated microwave load with separate adjustment of the module and the phase of the reflection coefficient are connected. In measurements, the alternating load is adjusted so that the readings of the indicator D, included in the shoulder (2) bridge, become equal to zero. The module and phase of the reflection coefficient of the device under test are read directly from the corresponding reference load scales

Such method of measurement is based on the assumption that at zero readings of the indicator the reflection coefficients of the tested and model loads are equal to each other. In practice, this assumption is not exactly true because the bridge devices used in measurements are not ideal.

Consider the measurement errors in detail caused by the nonideality of the bridge itself, assuming that as the latter is used a matched double tee

(Fig. 2.1). Let the indicator be perfectly matched, then the following expression can be obtained, establishing the relationship between the complex amplitude of the signal in the indicator arm 2 and the reflection coefficients of the tested  $G_x$  and the model  $G_0$  loads in the case where the double tee is not perfectly symmetrical and fully consistent

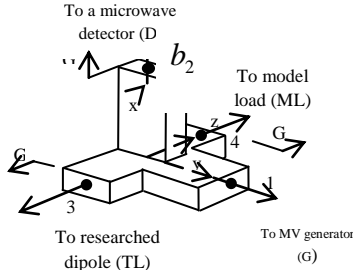


Figure 2.1 – Diagram of the balanced bridge for reflection coefficient measurement of microwave devices (G-generator; D-detector; VC-variable calibrated, ML – model load; TL-tested load)

Ignoring the imperfection of the model load and record the indicator we'll write

$$b_2 = S_{12} + \frac{1}{N} [S_{13}S_{23}\Gamma_x + S_{14}S_{24}\Gamma_0 + (S_{14}S_{23}S_{34} + S_{13}S_{24}S_{34}) - (S_{13}S_{23}S_{44} - S_{14}S_{24}S_{33})\Gamma_x\Gamma_0],$$

$$\text{где } N = (1 - S_{33}\Gamma_x)(1 - S_{44}\Gamma_0) - S_{34}^2\Gamma_x\Gamma_0.$$

If the bridge is symmetrical, i.e.

$$S_{33} = S_{44}; S_{33} = S_{14}; S_{24} = -S_{23}; S_{12} = 0,$$

that previous equation is simplified and takes the form

$$b_2 = -\frac{S_{13}S_{23}(\Gamma_0 - \Gamma_x)}{N}. \quad (2.1)$$

One of the main errors of the balance bridge is the error due to the direct connection between the shoulders (1) and (2) in the non-ideal bridge  $\delta|\Gamma_x|$ . This error can be estimated using approximate equality

$$\delta|\Gamma_x|_{\text{MAKC}} \cong \frac{2|S_{12}|\left(\frac{1}{\Gamma_x} + 2|S_{44}| + |S_{44}|^2\Gamma_x\right)}{\sqrt{(1 - |S_{11}|^2)^2(1 - |S_{22}|^2)^2}}, \quad (2.2)$$

that obtained directly from (2.2) and taking into account the bridge scattering matrix unitarity. Here  $\delta_1 |\Gamma_x|_{\text{MAKC}}$  is a maximum possible value of the error. This error increases as the measured reflectance decreases.

The inequality of power division between the shoulders (3) and (4) when the signal to the shoulder (1) may also cause measurement error. Using the expression (2.2) taking into account the unitarity of the scattering matrix of the bridge, we obtain the following approximate expression to estimate this error

$$\delta_2 |\Gamma_x| \cong \sqrt{\varepsilon^2 + 2 \sin^2 \frac{\gamma}{2}}, \quad (2.3)$$

$$\text{were } \varepsilon = |S_{13}| - \frac{1}{\sqrt{2}}; \gamma = \varphi_{13} - \varphi_{14}.$$

Reflections from the side shoulders of the double tee are another source of measurement errors. Assuming that the same loads are connected to the reference arm (4) and the measuring arm (3) of the bridge, and ignoring multiple reflections from these loads, using (2.1) we obtain the following expression for the measurement error of the reflection coefficient module in this case

$$\delta_3 |\Gamma_x| \cong \sqrt{\frac{|S_{33}|^2 - 2|S_{33}||S_{44}|\cos \zeta + |S_{44}|^2}{2}}, \quad (2.4)$$

$$\text{were } \zeta = \varphi_{44} - \varphi_{33}.$$

It is obvious that the measurement errors in the case where the bridge can be considered ideal, are directly equal to the calibration errors of the model load. The calculation of these errors, it is advisable to undertake when dealing with specific types of sample loads.

Consistent double tee can be used as unbalanced bridge for measurement of the module of the reflection coefficient [1, 2]. As in the case of the balance bridge, the generator can be connected not only to the shoulder (1), but also to the shoulder (2). Let's suggest that the generator is connected to the shoulder (1) first. In this case, there is certain dependence between the amplitude of the signal coming to the detector (shoulder 2) and the reflection coefficient module of the device under test. To determine it, we use the expression (2.54 4), obtained under the assumption that the generator and the detector are perfectly aligned, and the bridge is symmetric. If the reference load is also perfectly matched ( $G_0 = 0$ ), equation (2.1) is simplified by taking the form of

$$b_2 = -\frac{S_{13}S_{23}|\Gamma_X|}{|1 - S_{33}\Gamma_X|}. \quad (2.5)$$

Since the tee scattering matrix is unitary:

$$\begin{aligned} |S_{13}|^2 + |-S_{13}|^2 + |S_{11}|^2 &= 1; \\ |S_{23}|^2 + |-S_{23}|^2 + |S_{22}|^2 &= 1. \end{aligned}$$

Then we'll get:

$$\begin{aligned} |S_{13}| &= \sqrt{\frac{1 - |S_{11}|^2}{2}}; \\ |S_{23}| &= \sqrt{\frac{1 - |S_{22}|^2}{2}}. \end{aligned}$$

Substituting these values in (2.5), we obtain the extreme values of the signal power received by the detector:

$$P = \frac{1}{4} (1 - |S_{11}|^2) (1 - |S_{22}|^2) \frac{|\Gamma_X|^2}{1 \pm |S_{33}\Gamma_X|^2}. \quad (2.6)$$

As  $|S_{11}|^2 \ll 1$ ,  $|S_{22}|^2 \ll 1$  и  $|S_{33}\Gamma_X|^2 \ll 1$ , in the first approximation, we can assume that the power supplied to the detector is directly proportional to the square of the module of the measured reflection coefficient  $G_x$ , that is

$$P = \frac{|\Gamma_X|^2}{4}. \quad (2.7)$$

Using (2.7), one can write

$$A_{12} = 10 \lg P = 20 \lg |\Gamma_X| - 6 \text{ dB} = 20 \lg \frac{r_X - 1}{r_X + 1} - 6 \text{ dB}, \quad (2.8)$$

where  $r_X$  — tested load VSWR

It follows from (2.8) that VSWR measurements can be reduced to relative power measurements, i.e. measurements of attenuation between the shoulders (1) and (2). The relationship between the attenuation introduced by the bridge A12 and the VSWR of the test load corresponding to the expression (2.8) is shown in figure 2.2.

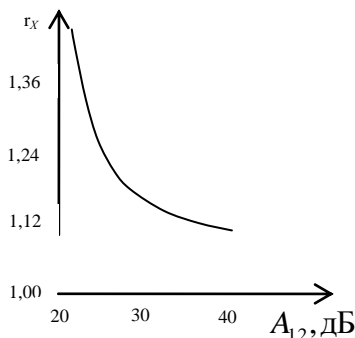


Figure 2.2. – The dependence of VSWR tested load from the transitional weakening, introducing by the ideal bridge

Number  $|S_{33}\Gamma_x|^2$  in expression (2.6), due to mutual reflections in the measuring arm, is associated with the so-called phase error of the bridge. Since the VSWR of the side shoulders of the double tee is usually noticeably different from the unit, this error is not negligible. Let, for example, VSWR of the measuring arm (3) (Fig. 2.1) equal to 1.1, then the measurement device with a VSWR = 2 the phase error will be in the range  $\pm 2.5\%$ . It can be seen from (2.2) that the phase error increases with the increase of the measured reflectance module.

In practice, the reference load is not perfectly consistent, which also leads to measurement error. The estimation of this error can be done by putting in the expression (2.1)  $S_{11} = S_{22} = S_{33} = S_{44} = S_{34} = 0$ .

$$\text{Thus we have } b_2 = -\frac{\Gamma_0 - \Gamma_x}{2}.$$

It means that the maximum and minimum values of the power supplied to the detector, in this case, will be equal to

$$P_{\text{МАКС}}^{\text{МИН}} = -\frac{(|\Gamma_0| \pm |\Gamma_x|)^2}{4}. \quad (2.9)$$

One can show that if  $|\Gamma_0||\Gamma_x| \ll 1$ ,

VSWR values obtained by measurements are in the range between

$r_x r_0$  и  $r_x / r_0$ , where  $r_0$  — VSWR of model load.

From (2.9) it can be seen that the maximum influence of reflections from the sample load on the output device readings, and therefore the maximum error will occur when measuring small reflection coefficients.

It should be noted that both the phase error and the error due to reflections from the reference load can increase if the generator and the detector are inconsistent. Calculation of errors in this case is much more complicated and it becomes expedient to introduce simplifying assumptions. As an example, let us estimate the errors for the case of an ideally symmetric bridge excited over the shoulder (2). Assume that the reference load included in the shoulder (4) is well matched (VSWR 1.05), and the VSWR of the axle shoulders and the connected components does not exceed 1.5...2.

Then one can write

$$b_1 \cong \frac{S_{23}S_{13}(1-S_{22}\Gamma_{\Gamma})(\Gamma_X - \Gamma_0)}{1-S_{11}\Gamma_{\Gamma}-2S_{22}\Gamma_{\Gamma}-(S_{13}^2\Gamma_{\Gamma}+S_{23}^2\Gamma_{\Gamma}+S_{33})\Gamma_X} . \quad (2.9)$$

According to the formula (2.9), the maximum possible values of sinfulness of VSWR measurement of the load connected to the shoulder (3) are calculated. Calculation results are shown in Fig. 2.3 and 2.9.

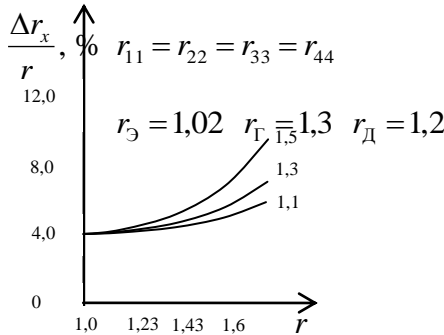


Figure 2.3 — Dependence of the relative error of measurement of VSWR from it values at

$$r_{11} = r_{22} = r_{33} = r_{44}$$



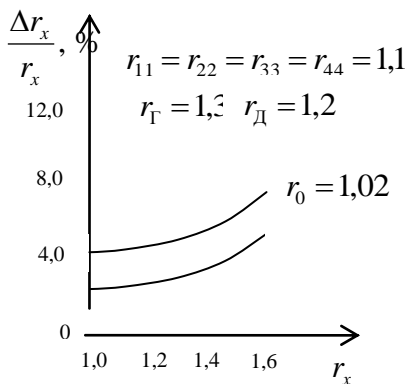


Figure 2.4 – Dependence of the relative error of measurement of VSWR from its values at  $r_{11} = r_{22} = r_{33} = r_{44}$

#### Conclusion.

The analysis of the balanced bridge operation on the basis of a double waveguide tee is carried out. The measurement of the standing wave ratio with the help of a tee can be reduced to relative power measurements, i.e. the measurement of attenuation between its shoulders. The researches carried out in the present work allow to draw the following conclusions:

— double tee can be used as unbalanced bridge for measuring the reflection coefficient of the various microwave elements;

— when carrying out the appropriate calibration procedures, it is possible to take into account the asymmetry of amplitude-frequency and phase-frequency characteristics of the shoulders of a double waveguide tee in the measurement mode in a wide frequency band.

The task of further research is to improve the calibration methods, measurement accuracy, level of automation and measurement performance.

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### **Аннотация**

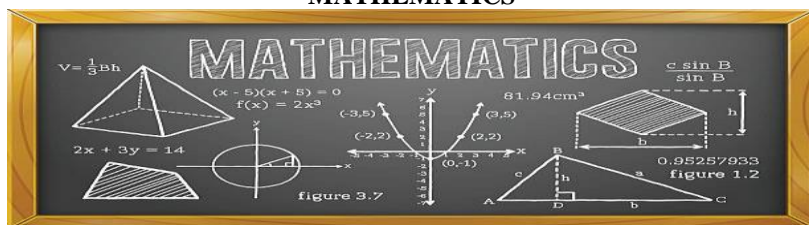
Измерительные преобразователи на основе волноводного тройника имеют широкое применение в силу относительной простоты реализации этих элементов. Однако волноводные тройники такого типа имеют и существенные недостатки, препятствующие достижению высокой точности измерения коэффициента отражения. Дальнейшее снижение точности измерения с помощью рассматриваемого преобразователя целесообразно осуществлять методами предварительной калибровки измерителя и дальнейшей коррекции погрешности в режиме измерения. Полученные в работе выражения дают при этом возможность учесть асимметрию плеч двойного тройника по амплитудно-частотным и фазо-частотным характеристикам и, таким образом, повысить точность измерения коэффициента отражения исследуемых двухполюсников в широком диапазоне частот.

**Ключевые слова:** балансный мост, модуль и фаза коэффициента отражения, калиброванная нагрузка, симметричный двенадцатиполусник, образцовая нагрузка, погрешность измерения, фазовая асимметрия, переходное ослабление, амплитудно-частотные характеристики, фазо-частотные характеристики.

**Summary.** Measuring transducers based on waveguide tee are widely used due to the relative ease of implementation of these elements. However, waveguide tees of this type have significant disadvantages that prevent achieving high accuracy of reflection coefficient measurement. Further reduction of measurement accuracy with the help of this converter is advisable to carry out methods of preliminary calibration of the meter and further correction of the error in the measurement mode. The expressions obtained in this work give an opportunity to take into account the asymmetry of the shoulders of the double tee in amplitude-frequency and phase-frequency characteristics and, thus, to increase the accuracy of the reflection coefficient of the studied two-poles in a wide frequency range.

**Key words:** balanced bridge module and the phase of the reflection coefficient, calibrated load, symmetrical twelve pole, model loading, measurement error, phase asymmetry, transient weakening, amplitude-frequency characteristics, phase-frequency characteristics.

## SECTION 3 MATHEMATICS



UDC 519.6

### HOW TO MAKE AN INFINITE AMOUNT OF CHOCOLATE? (BANACH – TARSKI PARADOX)

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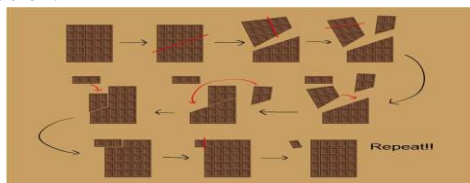
**Alexey Kabanov**

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*Sevastopol State University*

A few years ago there was a video spreading around the Web, showing the way to seemingly create chocolate out of nothing (picture 1). Maybe you've seen it before. This chocolate bar is 4 squares by 8 squares, but if you cut it like this you can rearrange the pieces like so and wind up with the same 4 by 8 bar but with a leftover piece, apparently created out of thin air. But, it's an illusion.



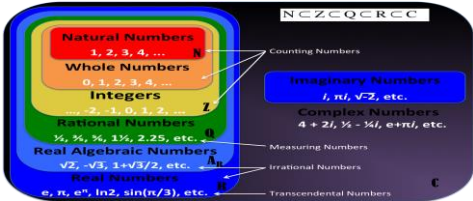
Picture 1 – Infinite chocolate illusion

In reality, the final bar is a bit smaller. It contains a one small square less chocolate. Each square along the cut is shorter than it was in the original, but the cut makes it difficult to notice right away. I mean obviously

you cannot cut up a chocolate bar and rearrange the pieces into more than you started with.

One of the strangest theorems in modern mathematics is the Banach-Tarski paradox. It proves that there is, in fact, a way to take an object and separate it into 5 different pieces. And then, with those five pieces, simply rearrange them. No stretching required into two exact copies of the original item. Same density, same size, same everything. To dive into the mind blow that it is and the way it fundamentally questions math and ourselves, we have to start by asking a few questions.

But first, let me remind you about different sets of numbers (picture 2). It is going to be useful in future. The smallest one is the set of natural numbers, the one's that the use to count things. Then Whole numbers, which are the same as natural, but added zero. The set of integers also contains negative numbers. Rational numbers contain fractions. Real numbers conta in also irrational and transcendental numbers.



Picture 2 – Different sets of numbers

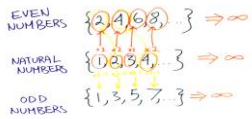
First, what is infinity? A number? I mean, it's nowhere on the number line, but we often say things like there's an infinite "number" of blah-blah-blah. And as far as we know, infinity could be real. The universe may be infinite in size and flat, extending out for ever and ever without end, beyond even the part we can observe or ever hope to observe. That's exactly what infinity is. Not a number per se, but rather a size. The size of something that doesn't end.

Infinity is not the biggest number, instead, it is how many numbers there are. But there are different sizes of infinity. The smallest type of infinity is countable infinity.

The number of hours in forever. It's also the number of whole numbers that there are, natural numbers, the numbers we use when counting things, like 1, 2, 3, 4, 5, 6 and so on. Sets like these are unending, but they are countable. Countable means that you can count them from one element to any other in a finite amount of time, even if that finite amount of time is longer than you will live or the universe will exist for, it's still finite.

Uncountable infinity, on the other hand, is literally bigger. Too big to even count. The number of real numbers that there are, not just whole numbers, but all numbers is uncountably infinite. You literally cannot count even from 0 to 1 in a finite amount of time by naming every real number in between. I mean, where do you even start? Zero, okay. But what comes next? 0.000000... Eventually, we would imagine a 1 going somewhere at the end, but there is no end. We could always add another 0. Uncountability makes this set so much larger than the set of all whole numbers that even between 0 and 1, there are more numbers than there are whole numbers on the entire endless number line.

Here's something else that is true but counter-intuitive (Picture 3). There are the same number of whole numbers as there are even and odd numbers. At first, that sounds ridiculous. There are only half as many even numbers as all whole numbers, but that intuition is wrong. The set of all whole numbers is denser but every even number can be matched with a whole number. You will never run out of members either set, so this one to one correspondence shows that both sets are the same size. In other words, infinity divided by two is still infinity. Infinity plus one is also infinity.



Picture 3 – Properties of infinity

A good illustration of this is Hilbert's paradox of the Grand Hotel (Picture 4). Imagine a hotel with an infinite number of rooms and a very hardworking night manager. One night, the Infinite Hotel is completely full, totally booked up with an infinite number of guests. A man walks into the hotel and asks for a room. Rather than turn him down, the night manager decides to make room for him. How? Easy, he asks the guest in room number 1 to move to room 2, the guest in room 2 to move to room 3, and so on. Every guest moves from room number "n" to room number "n+1". Since there are an infinite number of rooms, there is a new room for each existing guest. This leaves room 1 open for the new customer. The process can be repeated for any finite number of new guests.

As it turns out, you can subtract or add any finite number from infinity and still be left with infinity. It doesn't care. It's unending.

Banach-Tarski hasn't left our sights yet. All of this is related. We are now ready to move on to shapes. Hilbert's hotel can be applied to a circle.



Picture 4 – Hilbert's Infinite Hotel Paradox

Points around the circumference can be thought of as guests. If we remove one point from the circle that point is gone, right? Infinity tells us it doesn't matter. The circumference of a circle is irrational. It's the radius times  $2\pi$ .

So, if we mark off points beginning from the whole, every radius length along the circumference going clockwise we will never land on the same point twice, ever. We can count off each point we mark with a whole number. So this set is never-ending, but countable, just like guests and rooms in Hilbert's hotel. And like those guests, even though one has checked out, we can just shift the rest.

Move them counterclockwise and every room will be filled. Point 1 moves to fill in the hole, point 2 fills in the place where point 1 used to be, 3 fills in 2 and so on. Since we have a unending supply of numbered points, no hole will be left unfilled. The missing point is forgotten. We apparently never needed it to be complete.

There's one last needo consequence of infinity we should discuss before tackling Banach-Tarski. Ian Stewart famously proposed a brilliant dictionary. One that he called the Hyperwebster.

The Hyperwebster lists every single possible word of any length formed from the 26 letters in the English alphabet. It begins with "a," followed by "aa," then "aaa," then "aaaa." And after an infinite number of those, "ab," then "aba," then "abaa," "abaaa," and so on until "z," "za," "zaa," et cetera, et cetera, until the final entry in infinite sequence of "z"s.

Such a dictionary would contain every single word. Every single thought, definition, description, truth, lie, name, story. Everything that could be said using english alphabet. Obviously, it would be huge, but the company publishing it might realize that they could take a shortcut. If they put all the words that begin with a in a volume titled "A," they wouldn't have to print the initial "a." Readers would know to just add the "a," because it's the "a" volume.

By removing the initial "a," the publisher is left with every "a" word sans the first "a," which has surprisingly become every possible word. Just one of the 26 volumes has been decomposed into the entire thing. It is now that we're ready to investigate this article's titular paradox.

What if we turned an object, a 3D thing into a Hyperwebster? Could we decompose pieces of it into the whole thing? Yes. The first thing we need to do is give every single point on the surface of the sphere one name and one name only. A good way to do this is to name them after how they can be reached by a given starting point.

If we move this starting point across the surface of the sphere in steps that are just the right length, no matter how many times or in what direction we rotate, so long as we never backtrack, it will never wind up in the same place twice. We only need to rotate in four directions to achieve this paradox. Up, down, left and right around two perpendicular axes. We are going to need every single possible sequence that can be made of any finite length out of just these four rotations.

That means we will need left, right, up and down as well as left left, left up, left down, but of course not left right, because, well, that's backtracking. Going left and then right means you're the same as you were before you did anything, so no left rights, no right lefts and no up downs and no down ups. Also notice that we are writing the rotations in order right to left, so the final rotation is the leftmost letter. That will be important later on.

Anyway. A list of all possible sequences of allowed rotations that are finite in length is, well, huge. Countably infinite, in fact. But if we apply each one of them to a starting point and then name the point we land on after the sequence that brought us there, we can name a countably infinite set of points on the surface.

Let's look at how few strings on our list would work. Right up left. Okay, rotating the starting point this way takes us here. Let's colour code the point based on the final rotation in its string, in this case it's left and for that we will use purple. Next up – down down. That sequence takes us here. We name the point DD and color it blue, since we ended with a down rotation.

RDR, that will be this point's name, takes us here. And for a final right rotation, let's use red. Finally, for a sequence that end with up, let's colour code the point orange.

Now, if we imagine completing this process for every single sequence, we will have a countably infinite number of points and color-codes. That's great, but not enough. There are an uncountably infinite number of points on a sphere's surface. But no worries, we can just pick a point we missed.

Any point and color it green, making it a new starting point and then run every sequence from here. After doing this to an uncountably infinite number of starting point we will have indeed named and colored every single point on the surface just once. With the exception of poles.

Every sequence has two poles of rotation. Locations on the sphere that go through the starting points of combinations. For any sequence of right or left rotations, the poles are the north and south poles.

The problem with poles like these is that more than one sequence can lead us to them. They can be named more than once and be colored in more than one color. For example, if you follow some other sequence to the north or south pole, any subsequent rights or lefts will be equally valid names.

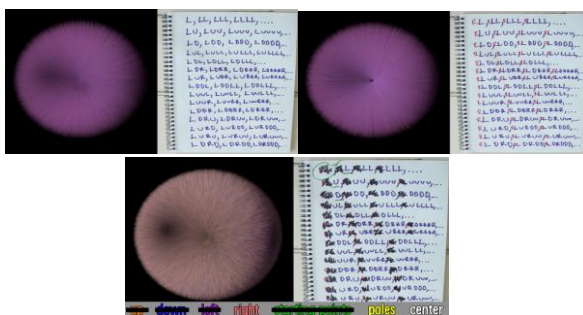
In order to deal with this we're going to just count them out of the normal scheme and color them all yellow. Every sequence has two, so there are a countably infinite amount of them.

Now, with every point on the sphere given just one name and just one of six colors, we are ready to take the entire sphere apart. Every point on the surface corresponds to a unique line of points below it all the way to the center point. And we will be dragging every point's line along with it.

The lone center point we will set aside.

Okay, first we cut out and extract all the yellow poles, the green starting points, the orange up points, the blue down points and the red and purple left and right points That's the entire sphere. With just these pieces you could build the whole thing. But take a look at the left piece (picture 5).

It is defined by being a piece composed of every point, accessed via a sequence ending with a left rotation. If we rotate this piece right, that's the same as adding an "R" to every point's name. But left and then right is a backtrack, they cancel each other out. And look what happens when you reduce them away.



Picture 5 – Left piece upclose

The set becomes the same as a set of all points with names that end with L, but also U, D and every point reached with no rotation. That's the full set of starting points. We have turned less than a quarter of the sphere into nearly three-quarters just by rotating it. We added nothing. It's like the

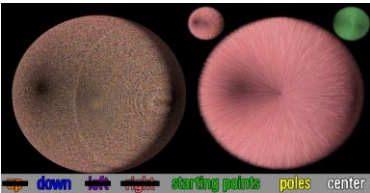


Hyperwebster. If we had the right piece and the poles of rotation and the center point, well, we've got the entire sphere again, but with stuff left over.

To make a second copy, let's rotate the up piece down. The down ups cancel because, well, it's the same as going nowhere and we're left with a set of all starting points, the entire up piece, the right piece and the left piece, but there's a problem here. We don't need this extra set of starting points. We still haven't used the original ones. Let's just start over.

We can just move everything from the up piece that turns into a starting point when rotated down. That means every point whose final rotation is up. Let's put them in the piece. Of course, after rotating points named UU will just turn into points named U, and that would give us a copy here and here. So, as it turns out, we need to move all points with any name that is just a string of us.

We will put them in the down piece and rotate the u piece down, which makes it congruent to the up right and left pieces (picture 6), add in the down piece along with some up and the starting point piece and, well, we're almost done. The poles of rotation and center are missing from this copy, but no worries.



Picture 6 – Making a second copy of the sphere

There's a countably infinite number of holes, where the poles of rotations used to be, which means there is some pole around which we can rotate this sphere such that every pole hole orbits around without hitting another. Well, this is just a bunch of circles with one point missing. We fill them each like we did earlier. And we do the same for the center point. Imagine a circle that contains it inside the sphere and just fill in from infinity and look what we've done (picture 7).



Picture 7 – Getting a new set of poles of rotation

We have taken one sphere and turned it into two identical spheres without adding anything. One plus one equals 1. That took a while to go through, but the implications are huge. And mathematicians, scientists and philosophers are still debating them. Could such a process happen in the real world?

I mean, it can happen mathematically and math allows us to abstractly predict and describe a lot of things in the real world with amazing accuracy, but does the Banach-Tarski paradox take it too far? Is it a place where math and physics separate? We still don't know. History is full of examples of mathematical concepts developed in the abstract that we did not think would ever apply to the real world for years, decades, centuries, until eventually science caught up and realized they were totally applicable and useful.

The Banach-Tarski paradox could actually happen in our real-world, the only catch of course is that the five pieces you cut your object into aren't simple shapes. They must be infinitely complex and detailed. That's not possible to do in the real world, where measurements can only get so small and there's only a finite amount of time to do anything, but math says it's theoretically valid and some scientists think it may be physically valid too.

There have been a number of papers published suggesting a link between by Banach-Tarski and the way tiny sub-atomic particles can collide at high energies and turn into more particles than we began with. We are finite creatures. Our lives are small and can only scientifically consider a small part of reality. What's common for us is just a sliver of what's available. We can only see so much of the electromagnetic spectrum. We can only delve so deep into extensions of space. Common sense applies to that which we can access. But common sense is just that. Common. If total sense is what we want, we should be prepared to accept that we shouldn't call infinity weird or strange.

The results we've arrived at by accepting it are valid, true within the system we use to understand, measure, predict and order the universe. Perhaps the system still needs perfecting, but at the end of day, history continues to show us that the universe isn't stranged. We are.

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**Аннотация.** Доказано, что Banach-Tarski парадокс действительно может случиться в нашем реальном мире. Это может произойти математически и математика сможет абстрактно предсказать и описать много вещей в реальном мире с удивительной точностью. Это теория, где математика и физика разделены.

**Ключевые слова:** Banach-Tarski парадокс, удивительная точность, бесконечность, математика.

**Summary.** It is proved that the Banach-Tarski paradox could actually happen in our real-world. It can happen mathematically and maths allows to predict and describe abstractly a lot of things in the real world with amazing accuracy. It is a place where math and physics separate.

**Keywords:** Banach-Tarski paradox, accuracy, infinite, Mathematics.

## SECTION 4

### ECOLOGICAL PROBLEMS AND THEIR SOLUTIONS



UDC 504.05

#### ORBITAL DEBRIS

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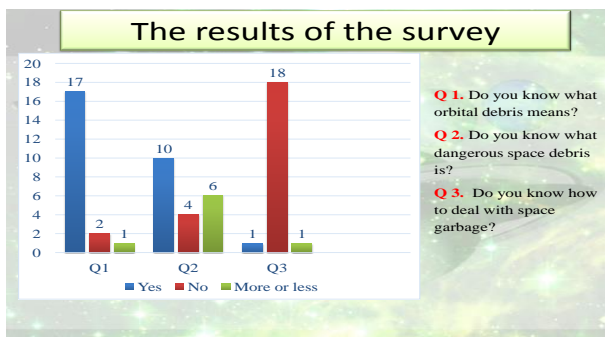
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Orbital debris means all artificial objects and their fragments in space that are already faulty, do not function and will never again be able to serve any useful purposes. Space debris includes both small items and larger ones, for example, debris of disabled satellites, blocks detached from rockets.

Where does orbital debris come from? First of all, it is waste of human activity. The more we launch satellites and other vehicles, the more we clog it. At present, around 12,000 different satellites revolve around the earth, only about 6% of them are workers, and they usually out of order with a high regular speed. Also, rockets, with satellites which are put into the orbit have a negative impact on the space. The reason is that about 10% of jet fuel remains in their tanks, which quickly transforms into a steam cloud with a threatening powerful explosion.

The recent survey in *Nakhimov Naval School Branch* found that many people knew the term “Orbital debris” but practically the most of them didn’t know how to deal with it.



Picture 1 – The results of the survey.

Over the past few years, more than 100 such explosions have already been observed in the near-Earth space. To get more knowledge about the universe, it is very important to develop space industry. During the past half-century, people began to explore the space with help of space vehicles, they surrounded the Earth by artificial satellites and wastes. All in all, these items began to threaten the exploration of the space.

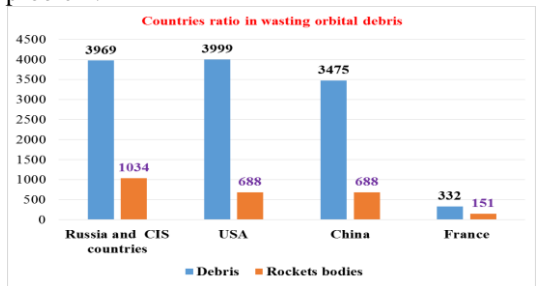
According to the European Space Agency, due to the constant work of men in space, a lot of debris in the orbit has accumulated and it starts to get out of control. Approximately 700,000 garbage objects larger than 1 centimeter and more than 170 million objects more than 1 millimeter have accumulated in the orbit.



Picture 2 – Debris in the orbit

All this trash fills the planet orbit has commercial and scientific value. The main threat of garbage is connected with the operation of several hundred different satellites used in telecommunication, weather, navigation, broadcasting and climate monitoring projects. If something happens with these satellites, it will not only seriously slow down research projects, but also the countries that rely on communication satellite technologies will suffer seriously. Among them, Russia and Commonwealth of Independent

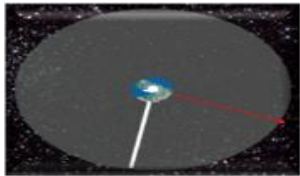
States, the USA, China. Scientists are sure that there is no longer time ignoring this problem. The risk of collision current working satellites with space debris is very high, and simple changes in their working orbits will not solve the problem.



Picture 3 – Countries ratio in wasting orbital debris.

The small pieces of orbital debris which is found in outer space not dangerous for the world's population. Sooner or later, any object as a result of friction about the remains of the atmosphere will brake, begin to fall to the Earth and burn in the upper atmosphere. The period of waste existence can range from several months to hundreds of years. and depends on the size of the object and the height of the orbit.

However, objects of artificial origin can be found in the zone of the geostationary orbit that is located at a distance of many kilometers from the earth's surface above the equator and not subjected to self-cleaning. The geostationary orbit is the most popular zone for humanity, and here different space vehicles have a unique property: their speed exactly corresponds to the speed of the Earth's rotation.



Picture 4 – Geostationary orbit.

This means that an artificial satellite without any expenditure of fuel and speed corrections constantly hangs over a specific point of the Earth (no other orbit is able to provide such an opportunity). The satellites have been launched into geostationary orbit since 1963, but within a year some of them cease to be active.

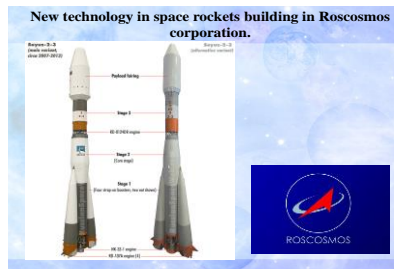
Currently, there are over one thousand objects and only 350 of them are operating satellites. Each year, two or three dozen new satellites and an incredible amount of debris are destroyed for various reasons. There is no atmosphere in the geostationary orbit, there is no any power there to slow

down the objects, so while they can't be not touched, they will be there forever, will ride and interfere with the operating and newly arriving spacecrafts.

Ecological issues in space technology and activity are becoming more and more important. The best space strategies for the future cannot be implemented without a move to more effective and eco-friendly technologies. Space has colossal potential to play a vital role in the future safety and stable development of humanity. However, the space industry is lagging behind in the worldwide process of moving to a green economy. Are green space equipment, technology and activity possible? And if so, what should be the strategy for the transition to green space?

Green technology is that which allows one to achieve stated goals while using minimal resources and with the least possible environmental pollution. It has as its mission the 'ecologisation' of equipment and activity, and is a powerful catalyst for the transition to a new technological culture, a transformation of economy and business. Ideally, green space would only use green technology, achieving space activity goals with minimal resources and pollution.

In April 2012, Roscosmos presented a new space activity strategy, developed in the industrial market paradigm: to increase manufacturing, restore infrastructure, improve quality control and increase global market share.



Picture 4 – Roscosmos projects in space industry.

Some words about "Space monitoring system". It's a special strategic system, the main task of which is to monitor artificial satellites of our planet, as well as other space objects. It is an integral part of the troops of the Air and Space Defense.

As far as the analysis of the maneuvers of reconnaissance space vehicles which carried out in outer space makes possible to predict the time of the first massive air and missile strike of an airborne operation. It is sufficient to have an idea of the grouping of spacecraft deployed by a probable enemy.

All in all, scientists are looking for different ways to track debris and clean outer space. One of the main ideas is to use special satellites that will capture debris and direct it to the surface of the planet. Also, it is considered the variant of collecting usable fragments and recycling them.

**Аннотация.** К третьему тысячелетию человечество активно изучает и исследует космос. Число космических полетов растет, но они постоянно сталкиваются с проблемами. Один из них – экология космического и орбитального мусора. Также ученые работают над новой технологией, которая сможет решить проблему загрязнения космоса.

**Ключевые слова:** орбитальный мусор, космическая техника, спутники, геостационарная Орбита, космический аппарат, Роскосмос, система космического мониторинга, космическое пространство.

**Summary.** By the third millennium, mankind is actively studying and exploring the space. The number of space flights is growing, but they are constantly faced with problems. One of them -the ecology of the space and orbital debris. Also scientists work over new technology which will be able to solve the problem of space pollution.

**Key words:** orbital debris, space technology, satellites, geostationary orbit, spacecraft, Roscosmos, space monitoring system, outer space.

UDC 502.36

## **WAYS TO PROTECT THE ENVIRONMENT IN COUNTRIES WITH HIGHER ENVIRONMENTAL EFFICIENCY**

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In the Russian Federation, 2017 is declared a year of ecology, therefore, it can be concluded that the issue of environmental protection in our country is still quite relevant. According to official data, about 40% of the territory of Russia, where more than 60% of its population live, are zones of ecological disadvantage, due to radiation and chemical pollution of territories, release into airspace and discharge of toxic substances into water



bodies and other negative impacts. No matter how pitifully it sounded, you can fight it [1, p. 3].

There are several countries that are able to protect the surrounding environment and from which one can take an example. These are countries with high environmental efficiency. Leaders among them are Finland and Sweden.

Let's consider this problem in Finland. For the purity of water, the best cleaning filters are used and regular replacement of pipes allows not to chlorinate water, which allows it to drink directly from the tap. In 80% of local lakes, the state of water was recognized as excellent. In such lakes you can observe the abundance of fish. This is due to the fact that each fisherman pays a license to restore fish resources.

For garbage, as the most common type of contaminants, several types of containers were created: cartons of milk go to one, newspapers and magazines to the other, glass and iron to the third, etc. Later all this is recycled, so-called wasteless production.

Paving the highways, people tried to preserve the natural habitats of animals. This is why human paths here rarely intersect with the routes of rabbits, foxes and moose. In winter Finnish roads are usually sprinkled with granite chips, which are collected in the spring by vacuum cleaners. This method is less harmful to the soil.

To preserve the cleanliness of air in Finland it is prohibited to use engines at idle for more than 2 minutes. Every year, a day without cars is celebrated, and an additional tax is imposed on fuel and transport.

The store often uses biological bags, which are subsequently processed, and plastic bottles can be taken for money. Also it affected taxes. The amount of taxes on environmental protection amounted to approximately 5 billion euros. In addition, it was collected 0.9 billion euros for the maintenance of water resources and waste treatment. Approximately half of the funds received were taxes on cars and fuel. Dog tax (50 euro per year for each pet) also goes to protect the environment [2, p. 3]

So protect the environment in Finland. In principle, these methods are similar in many countries, but there are also some interesting ones, for example in Sweden.

The Swedish parliament, realizing what they are now creating for future generations, has created the program "The Purpose of Generations", which includes 16 directions. In general, the goal of Swedish environmental policy is to pass on to the next generation a society in which the main environmental issues in Sweden have been resolved without increasing the problems of environmental protection and health problems outside the Swedish borders.

This generation goal, which determines the direction of environmental policy, is to give an idea of the values that must be protected and the changes in society that are needed if the desired quality of the environment is to be achieved. It also calls for ambitious environmental policies – in Sweden, within the EU and in international contexts. To implement this program, they are aiming for 2020 [3, p. 3]

There are interesting ways in Russia. Let's consider measures to protect the environment. An effective method for cleaning contaminated soils is the breeding of special worms that neutralize dangerous compounds. With erosion, the planting of green plantations helps to fight. Specialists in ecology and environmental protection recommend, if possible, to preserve the most natural restoration of the tree population so that genetic diversity is not disturbed.

An important way to combat air pollution is the gradual transition to vehicles with recuperative braking - electric vehicles. Wastewater treatment and the transition of production plants to non-waste technologies also contribute to improving the environmental situation.

It's not a secret that the problems with the environment are becoming more serious. Fortunately, the government is already thinking about their decision. I am sure that sooner or later, and in the Russian Federation, there will come a time when we will get rid of this issue when people come to our country, simply because it is nice to live here.

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**Аннотация.** В данной работе рассматриваются различные методы защиты окружающей среды в странах с наиболее высокой экологической эффективностью. Особое внимание уделяется Финляндии и Швеции, а также интересным способам решения данного вопроса, таким как программа “Цель поколений”, которая была создана Шведским парламентом, налогообложение Финляндских водителей, владельцев животных и рыбаков.

В статье описаны самые продуктивные способы поддержания хорошего состояния окружающей среды. На основе данного материала определяется важность задачи – защитить мир вокруг нас, позаботиться как о своём будущем, так и о будущих поколениях.

**Ключевые слова:** защита, окружающая среда, экология, угроза, способы защиты.

**Summary.** In this paper, various methods of environmental protection in countries with the highest environmental efficiency are considered. Particular attention is paid to Finland and Sweden, as well as interesting ways to solve this issue, such as the "Generation of Generations" program, which was created by the Swedish Parliament, the taxation of Finnish drivers, owners of animals and fishermen.

The article describes the most productive ways to maintain a good state of the environment. Based on this material, the importance of the task is determined - to protect the world around us, to take care of both our future and future generations.

**Keywords:** protection, environment, ecology, threat, ways of protection.

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## NEW TECHNOLOGIES FOR OCEAN CLEANING

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Seas and oceans play an essential role in human life. Oceans serve for global transportation of goods and there are communities, tourists' attractions and activities, all depending on healthy oceans and seas. But in recent years, there is phenomenon of increasing water pollution. The most important sources of pollution are sewage, petroleum oil, plastics and other waste of human life. We exploit seas and oceans, including their bottom and coast, more and more intensively. Do we want to swim in polluted water?

Rubbish not only spoils beautiful seascapes, but also has a negative influence on marine life. In addition, rubbish is not only thrown to the

shore, most of it remains in the water and accumulates on the sea bottom, where it is difficult to clean.

Northern Europe was the first in the world that joined the project to cope with marine rubbish.

Two Australian surfers – Peter Seglinsky and Andrew Turton invented a device for cleaning the water from any floating rubbish. Surfers created their response to pollution of the world's oceans – “The Seabin Project” [1].



The floating cleaner “Seabin” has already collected rubbish from the sea surface in the coastal waters of Helsinki, the capital of Finland.

“Basket” - “Seabin” draws in itself plastic bottles and bags, cigarette butts, paper, food packaging, oil and oil products and other wastes of human civilization (Fig.1). The Basket collects up to 1.5 kg per day of floating trash on the surface of a size of 2 mm in diameter, which is equivalent to 20

thousand plastic bottles or 83 thousand plastic bags per year [3].

“Basket” consists of a container made from reused materials. Inside the container there is an electric pump plugged directly into 110/220 V outlet and capable of operating under water, displacing 25.000 Lph (liters per hour), and a bag of natural porous material.

The principle of operation of the basket is borrowed from a vacuum cleaner: the "basket" drives water and the debris floating in it through itself. Debris settles in a bag, and water freely passes through. The clean water is then pumped back into the sea, leaving litter and debris trapped in the catch bag. In the current version of the device, electricity is supplied to the pump via cable from the shore. In the future, developers hope to create autonomous power from solar panels or wind generators [2].

The Seabin can be installed in any “Debris problem area” on a floating dock where the wind and water currents could push the debris directly to the Seabin. The volume of Seabin is up to 12 kg of waste products, including layers of oil and other oily liquids. Thus, for cleaning a usual sized bay approximately about four Seabins will be enough.

The company RanMarine developed another water cleaning device. This is a marine vacuum cleaner “Waste Shark” – a drone that catches rubbish on the water surface (Fig.2).

**Figure 2. Marine Vacuum Cleaner "Waste Shark"**



To clean up a small part of this rubbish Richard Hardiman from RanMarine Company uses a small robot in the Rotterdam port – floating “Waste Shark” – one of the two newest innovations in the harbor. A drone is able to collect up to 500 kilos of rubbish [5].

To collect as much rubbish as possible the Waste Shark has the size of a car and is hanging from 35 centimeters beneath the water surface. The main goal is to catch as much waste as possible, before it is washed out into the sea. The system works completely autonomous, and it goes back to its station when it is filled with trash, like a vacuum cleaner. It is even able to remember which routes contained more rubbish, so it returns to this route regularly.

There is more wide scale way to cope with rubbish, called Sea Vacuum Cleaner “SeaVax”. It's a ship powered by solar energy and wind power, developed by the inventors of Bluebird Marine Systems.

The “SeaVax” vessel operates on the same principle as “Seabin”, directing water flows through the "sieve", while moving forward. The length of the ship is 44 meters and it is completely autonomous, which means it can work not only on the shore.

A vacuum pump with is width of 13.5 m is placed on the boat, which, like the whole boat, is fully automatic. Solar panels and two wind turbines generate electricity for electric pumps and filters (Fig.3). They suck in hard plastic pieces and extremely dangerous microplastics. Then the shredding machine shreds large pieces and the resulting plastic flour accumulates in the hold, designed for 150 tons of cargo. Periodically, “SeaVax” returns to shore to discard another portion of crushed and recyclable waste.



Figure 3. Sea Vacuum Cleaner "SeaVax"

The creators expect that the "vacuum cleaner" for plastic waste will be able to generate enough energy to distill an average of 89.9 million liters of sea water per year. Thus, about 24,000 tons of plastic debris will be collected. A small fleet of such boats will clean the ocean from plastic for 5-10 years with a minimum of human resources [4].

"SeaVax" is equipped with underwater sensors that will be able to accurately distinguish living objects in the ocean from inanimate, no matter how small these objects are. Therefore, the ingress of fish into the pump is excluded. If there is a threat of getting into the pump of living organisms, the filter will automatically be covered with a shield.

A smart boat can also deal with the storm. Special sensors on board constantly analyze the environment, and in the event of worsening weather conditions, "SeaVax" will immediately stop the turbines and drop anchor.

In general, "SeaVax" is much better than its analogue "Seabin", because it can be freely launched for long distances for a long time. In my opinion, projects that was described above are the most effective way to clean not only the ocean and sea waters, but also the water of polluted rivers, such as the Ganges, the largest and most polluted river in India. As well as cleaning of Nigerian and Australian waters from oil products.

In the past five years a lot of projects directed to clean the ocean from rubbish were created. Unfortunately, most of them quickly faded. The fact is that the microplastic in the ocean is like smog over a large city, almost imperceptible. For several years plastic rubbish turns into pure poison in the sea waters. However, there is a chance to deal with this problem nowadays – using "Waste Shark", "Seabin" and "SeaVax" technologies.

To help the planet waters get rid of pollution is the mission of all existing ecology and environment preserving projects! Working together, we can achieve this goal!

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**Аннотация.** Статья посвящена решению одной из важнейших экологических проблем – проблеме загрязнения морей и океанов микропластиком. Проекты, описанные в статье – это вакуумные очистители, называемые “Seabin”, “SeaVax”, “Waste Shark”, которые созданы для очистки океана от различного вида мусора. Создатели этих дронов утверждают, что небольшой флот таких лодок очистит океан от пластика за 5-10 лет с минимальными затратами человеческих ресурсов. Главная цель статьи – рассказать о более эффективных и современных способах борьбы с загрязнениями воды.

**Ключевые слова.** “Seabin”, “SeaVax”, “Waste Shark”, вакуумный очиститель, плавающий очиститель, загрязнение океана, морской мусор, микропластик.

**Summary.** The article is devoted to solution of one of the most important environmental problems – the problem of pollution of the seas and oceans by microplastics. Projects described in the article are the vacuum cleaners called "Seabin", "SeaVax" and "Waste Shark" created to clean the ocean from various types of debris. The creators of this drones claim that a small fleet of such boats will clean the ocean from plastic for 5-

10 years with a minimum of human resources involvement. The main goal of the article is to tell about more effective and modern ways to cope with marine rubbish.

**Keywords.** “Seabin”, “SeaVax”, “Waste Shark”, vacuum cleaner, floating cleaner, ocean pollution, marine rubbish, microplastic.

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## **MANAGMENT OF THE CHEMICAL COMPOSITION OF SURFACE WATERS OF RIVER BASINS IN THE CLEARING MINE WATERS**

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In order to reduce the threat scarcity of water resources, deterioration of their quality, it is advisable to switch the basin principle of water resources management, which corresponds to the best international practices. The full measure is for regions with a high concentration of coal-mining enterprises, which located in the Central and Western Donbass.

The task of managing the quality of river waters of coal-mining regions is to solve control of the negative impact to the storage pond in accordance with the hydro-hydrochemical regime of the natural watercourse [1].

The proposed method is basing on information and expert system for assessing the impact of a storage pond on a natural watercourse, which including:

1. Preparation of initial data on hydrological and hydrochemical blocks, choice of approach to their calculation;
2. Creation of a data bank: expert evaluation based on the criteria developed, optimization modeling and forecasting;
3. Development of recommendations for managing the influence of the storage pond within the river basin

Mine waters are formed as a result of the filtration of underground and surface waters into underground mine works. Passing mountain works, water exposed to various kinds of pollution. One of the main features of mine waters is content salt increased [2].



It is established that the following regularity of formation of river waters is the basis of regulation of technogenic influence: the mineralization and ionic composition of the water of the watercourses is dynamically dependent on the intra-annual and multi-year distribution of flow rates.

Calculations, carried out within the research area, show that in the outlet from the industrial zone, taking into account the influence of the mines of the Central Donbass, Samara's mineralization ranges between 2.25-3.02 g / l under the condition of a controlled discharge, 2.37-2.95 g / l for a uniform discharge and 1.77-2.81 g / l for salvo discharge of mine waters.

In addition, to quantitative advantages in certain periods of the year, controlled discharges have another very important advantage: maintaining a constant mineralization in the natural reservoir after the discharge of mine waters (without imposing hydrochemical characteristics of the inflow). As it is known, the consistency of mineralization is a sign of the stability the aquatic ecosystems of the river basin.

The solution of the task of managing the influence of storage ponds and mines on river basins will be able to maintain a constant chemical composition of river waters, to simulate and predict various variants and scenarios for their change, which will minimize the possible increase on the level of mineralization.

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**Аннотация.** В работе приведены теоретические основы управления качеством речных вод, установлены величины минерализации при различных вариантах сброса шахтных вод.

**Ключевые слова:** шахтные воды, управление, речной бассейн.

**Summary.** The theoretical principles of river water quality management are presented in the work, the mineralization values are determined for various variants discharge of mine waters.

**Key words:** mine waters, management, river basin.

## **WATER POLLUTION BY MICROPLASTICS AND MICROBEADS**

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The poet Auden said, "Thousands have lived without love; none without water." The sea and ocean waters are truly considered to be the nature's best jewel! Ninety-seven percent of Earth's water is the ocean. With every drop of water you drink, every breath you take, you're connected to the sea. No matter where on Earth you live!

Most of the oxygen in the atmosphere is generated by the sea. The ocean drives climate and weather, stabilizes temperature, and shapes the chemistry of Earth. It provides home for about 97 percent of life in the world, and probably in the Universe! No water – no life; no blue – no green!

Today along with military conflicts and the issue of nuclear disarmament environmental problems are among the most acute for humanity. The processes occurring in lithosphere (which is home to humanity) are closely related to the processes taking place in the hydrosphere. The problem of pollution of the oceans is extremely urgent, since it affects the flora and fauna of not only the oceans, but also, indirectly, the flora and fauna of the land.

Therefore, it is extremely important to analyze one of the environmental problems directly affecting the water resources, the problem of pollution of the seas and oceans with microplastics.

Approximately 10-20 million tones of plastic end up in the sea waters each year. A recent study estimated that 5.25 trillion plastic particles weighing a total of 268,940 tons are currently floating in the world's oceans! This plastic debris results in about \$ 13 billion a year in losses from damage to marine ecosystems, including financial losses to fisheries and tourism as well as time spent for cleaning beaches. Seabirds, whales and dolphins can become entangled in plastic matter and floating plastic items such as discarded nets, docks, boats and consequently can transport

microbes, algae, invertebrates, and fish into non-native regions, affecting the local ecosystems [1].

First we need to understand what microplastics is. Microplastics and microbeads are tiny pieces of plastic sized less than 5 millimeters which end up in the world's seas and oceans. They cause environmental damage and as yet unknown effects on marine creatures and the wider ecosystems which support marine life. Microplastics mainly arise from large plastic objects, which accumulate in the oceans and slowly break down into smaller pieces. Simply put, microplastics are formed when larger pieces of waste plastic end up in the ocean. They begin to break down into smaller and smaller pieces and over time, releasing microplastics. The treatment facilities cannot "catch" the microplastic, because of the small size of the pellets, so it cannot be collected for further processing [4].

Microplastic is an excellent adsorbent. It "absorbs" harmful impurities in seawater, for example polychlorinated biphenyls (PCBs) (Fig.1) – substances capable of causing the development of malignant tumors turning into a sort of delayed-action bomb. Having a small specific gravity, such particles float on the surface or in the water column, becoming an easy prey for fish and birds that take them for food. In immature fish this microbead consumption inhibits the growth of fish as the extra energy that the fish expend trying to digest the plastic also makes them slower and more docile, and therefore easier for predators to catch.

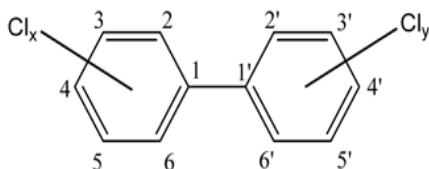


Figure 1 – Polychlorinated biphenyls

Marine organisms which filter food can also be badly affected by microplastics or microbeads, with species such as sea cucumbers having their digestive tracts blocked with microplastics and microbeads. Lugworms are a filter feeding species which may also be badly affected by high levels of microplastics being found in their habitat. Although exactly how lugworms will be affected is currently unknown. Some species of crabs and lobsters have been found with microplastics stuck in their gills [2]!

There is now serious concern that there is so much plastic pollution in the seas and oceans that it is inevitable that humans will ingest plastic through the fish and seafood they eat. While large fishes might not directly

eat microplastics they may accumulate microplastics in their bodies when they are immature fry, or through eating smaller fish which are full of microplastics.

A study in the science journal *Nature* found that a quarter of fish and shellfish bought at markets in Indonesia and California contained plastic (Fig.2), while researchers at the University of Ghent in Belgium have calculated that people eating shellfish on a regular basis will consume 6,400 pieces of microplastic a year. A small proportion of these will accumulate in the human body, and there must be a substantive research carried out to understand the long-term effects this fact will have on human health.

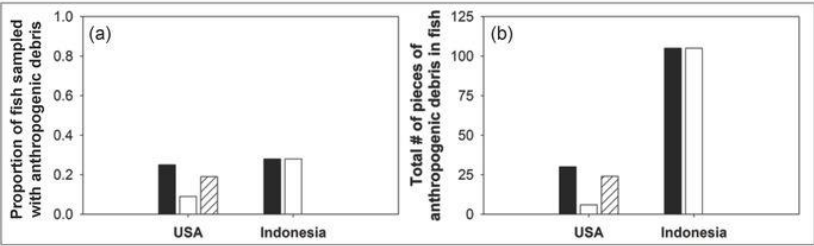


Figure 2 – Anthropogenic debris recovered from fish sampled from the USA and Indonesia

With so much plastic already in the world's seas and oceans there are major concerns that the damage has already been done, and measures we now take will be effective only in limiting how bad things can get into the water.

The issue of plastic pollution is a very complicated one and many industries are responsible for it. The fashion and beauty industry has a huge impact on it. Basically, microplastics are hidden in all synthetic garments and many cosmetic products such as toothpaste, scrub or shower gel. But also bigger pieces of plastics such as packaging material turn into microplastics, end up as invisible parts of the huge plastic island.

There is a gigantic plastic island (which has the approximate size of Texas) floating in the North Pacific Ocean: the so-called Great Pacific garbage patch (Fig.3).

Microplastics is found in every part of the ocean but the Great Pacific garbage patch shows the highest concentration of plastic. So far, nobody has a solution or plan to clean the ocean from the plastic and the garbage island keeps growing bigger and bigger.



Figure 3 – Great Pacific Garbage Patch

Since plastic materials are not biodegradable like organic materials, all things, which ever have been made of plastic still exist on the planet as invisible pieces of microplastic. And the other bad fact is that plastic can also contain all sorts of toxic substances such as antistatic and softening agents and even metals. Scientists have found a high concentration of toxic substances on the porous surface of plastic particles.

But how to avoid microplastics? The main sources of microplastics are textiles and cosmetics. Let's consider a few rules for cosmetics: check the labels of each product you want to buy. Try to buy organic cosmetic products as well as eco-friendly plastic-free packaging. If you discover one of the following ingredients listed on the packaging, keep your hands off the product! Here is a list of the most used types of microplastics:

Polyethylene (PE), Polyethylene Glycol (you can find them as PEG- followed by a number for example PEG-32), Polypropylene (PP), Polymethyl methacrylate (PMMA), Polyethylene terephthalate (PET), Nylon.

About textiles: each time we wash a piece of synthetic garment, tiny fibers of polyester or nylon are released and washed off by the washing machine. There is no filter that can hold these plastic microfibers back and so they are sent out with the drain water. Even though there was a prototype developed to filter synthetic fibers, it has never actually been realized because nobody funded the project [3].

So, as long as we don't have filter systems and microplastics are not banned by the beauty and fashion industry, take a close look at what you

buy and how you treat it. Think of alternatives and buy organic materials wherever possible.

How to save the oceans from microplastic pollution? Unfortunately, there is no definite way for microplastics to be removed from the sea leaving plankton and other microscopic sea creatures, which are essential to marine life, unharmed. For this reason the only thing that we can do is to reduce the amount of plastic that we dump into the sea in the future.

In connection with the growth of global production, the problem will only worsen, so it is important to develop a strategy for its solution at the international level. The next 10 years may be the most important. And in the best chance the next 10,000 years humans will have to protect what remains of the natural systems that give us life. To cope with climate change, we need new ways to generate power. We need new ways, better ways, to cope with poverty, wars and disease. We need many things to keep and maintain the world. But, nothing else will matter, if we fail to protect the ocean for our future generations! Our fate and the oceans are the one!

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**Аннотация.** Статья посвящена одной из важнейших экологических проблем – проблеме загрязнения морей и океанов микропластиком. Авторы приводят основные характеристики микропластика и его отличия от обычного пластика. Рассмотрены главные источники загрязнения микропластиком водных ресурсов, а также его влияние на окружающую среду, организм человека и морских животных. Сделаны выводы о невозможности «вылавливания» микропластика известными на данный момент способами. Как основной способ решения проблемы, приведен план

предотвращения попадания микропластика в сточные воды и, в дальнейшем, мировой океан.

**Ключевые слова.** Микропластик, микрошарики, пластик, загрязнение микропластиком, экологические проблемы, загрязнение воды.

**Summary.** The article is devoted to one of the most important environmental problems – the problem of pollution of the seas and oceans by microplastics. The authors give the main characteristics of microplastics and its differences from conventional plastics. The article also deals with the main sources of microplastic contamination of water resources, as well as its influence on ecology, human organism and marine creatures. Conclusions are drawn about the impossibility of "catching" microplastic by methods known at the moment. As the main way to solve the problem the plan to prevent the entry of microplastics into wastewater and, subsequently, into the global ocean was proposed in the article.

**Keywords.** Microplastics, microbeads, plastic, microplastic pollution, environmental problems, water pollution.

## SECTION 5: THE ACTUAL PROBLEMS OF ECONOMICS



UDC 334.723

### **IMPLEMENTATION OF INNOVATIVE MANAGEMENT TECHNOLOGIES IN THE WORK OF SMALL BUSINESSES**

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In Russia at present time, the state is interested in the reliable formation of entrepreneurship, but the mechanisms that should be implemented, the developed programs are not effective enough, there is no system support in the direct realization and implementation of these programs in the work of small and medium-sized enterprises. Professional training of entrepreneurs is the key to their continued success. Mature entrepreneurs are easier to adapt and fill the missing knowledge and skills, as they are constantly rotating in the business environment. It is very difficult for start-up entrepreneurs to navigate the market, so it is very important to correctly determine their economic activities, to get a professionally oriented business education [4]. The introduction of innovative educational programs based on a comprehensive study of market instruments is an important aspect that is able to form an entrepreneur competent understanding of the financial miasma and their management, a rational approach to the organization of their own business from the standpoint of marketing and logistics and many other effective developments. It is modern educational programs that will provide a fundamental basis for business leaders to understand and implement innovations in the work of enterprises. Creating a full-fledged business environment is the main task of our society. Small enterprises are the most competitive, because of the small size it is easier for them to start developing and implementing new technologies in the work of the enterprise, with the least cost and time.



Today, research in the field of entrepreneurship and innovation is of particular relevance, since there is a rather low level of innovation in the small business sector. The reason is a lack of conditions for innovative activities of small enterprises, as well as the difficulty of assessing the effectiveness of innovation in the enterprise. Managers of enterprises should be familiar with modern management technologies; this will be the key to success and innovation in the enterprise. Innovations in management are closely interrelated with the introduction of innovations in the organizational and economic activities of enterprises without knowing modern mechanisms of management, it is very difficult to the head to keep up with time; it will negatively affect competitiveness and activity of the enterprise [5].

Innovation management is an organizational and managerial activity which is created for receiving economic, ecological and social results by use of innovations in activity of the enterprise.

The main problem of innovation integration in the enterprise is the complexity of organizational processes. The development of innovations depends on the extent to which the scientific and technical system of the enterprise is ready to accept any innovative task and evaluate it correctly. The task can be perceived if the production system is ready for its implementation. The introduction of innovations creates the need for retraining of specialists, advanced training of managerial personnel, as a tool to improve the efficiency of the enterprise.

The problem of the state's participation in the innovative development of enterprises is also relevant. At the present stage, there is an inefficiency of financial, economic and legal support tools used by the state [1].

The solution may be to encourage investment in research activities of small and medium-sized enterprises, the development of their relations with scientific organizations, direct financial support, as well as the implementation of joint projects on the basis of public-private partnerships.

The main purpose of innovation is to increase productive work, as well as the ability to be a competitive enterprise by updating products, technologies, as well as the introduction of organizational and economic changes and innovation management.

Innovation management is based on the improvement and introduction of new technologies and developments in the organizational and economic activities of enterprises.

Tasks of innovation management are following:

- development and implementation of innovative products;
- improvement of earlier products;
- improvement of the financial and economic mechanism.

An important issue of innovation management is financial security, without which innovation policy can not be implemented. Financing includes monetary relations between the enterprise and other organizations concerning payment of deliveries, production, calculations with founders.

The main sources of funding are [2]:

- 1) formed financial resources on account the expense of own funds: the income and revenues;
- 2) mobilized funds: securities, leasing, capital investment;
- 3) redistribution finance: insurance indemnities, receipt of dividends on securities.

To implement innovation management in the enterprise system, it is necessary to change the strategy. New technologies are essential tools for the effective functioning of competitiveness. Effective functioning can be achieved through:

1. improvement of product quality;
2. development of profitable business projects;
3. direct participation in the development of innovative solutions.

Above mentioned facts proves a need to introduce innovative technologies into the work of enterprises with a view to their further development in modern conditions.

This can be done using the following methods [3]:

1. The forced method is based on overcoming resistance by staff. It can be used under conditions of severe time constraints.
2. Method of adaptive deviations: changes are gradual, with a long period of time.
3. Crisis management: changes take place in the external environment that could threaten the improvement of the company's policy.
4. Resistance control: this method is intermediate between the first and the second. It can be applied in terms that are set by the development of events in the external environment.

The innovations development in the field of financial management is very important not only in Russia, but also around the world. Direction of innovation management in the search and further development of new technologies in the enterprise. Implementation is a sign of the transition of the enterprise to a higher level of development.

In general, the implementation of innovation activities can be carried out in the following stages [3]:

1. implementation of innovative scientific developments in the work of the enterprise
2. development of plans and programs of innovative activity
3. development and analysis of innovations

4. financial security
5. providing enterprises with qualified personnel
6. implementation of a single innovation policy
7. consideration of projects on development of innovative technologies
8. implementation of innovative educational programs

На сегодняшний день многие предприятия, создают научно-технические комплексы, которые поэтапно проводят разработку и внедрение инноваций в сектор производства и услуг.

Today many enterprises create scientific and technical complexes which carry out development and introduction of innovations in sector of production and services step by step.

Therefore, the innovative activity of the enterprise, of course, should focus on meeting the needs of society, but at the same time should be aimed at increasing productivity from the use of new technologies. The problems of determining the efficiency of innovation and investment development of enterprises are extremely important. Using the methods discussed above, it is possible to assess the performance of the enterprise innovation system and the degree of realization of goals and objectives in the future.

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Солодова С.В. // Проблемы формирования себестоимости деятельности субъектов малого предпринимательства: монография / С.С. Евдокимова, С.А. Карабинцева, О.А. Коваленко и др. Волгоград: Сфера, 2018. – 166 с. – С. 138-139/ ISBN 978-5-6040811-3-6

**Аннотация.** Рассмотрено внедрение инновационных образовательных программ основанных на комплексном изучении рыночных инструментов как важный аспект в формировании грамотного представления о финансовых миазмах предпринимателя. Изучены задачи инновационного менеджмента. Представлены новые технологии и стратегии для внедрения инновационного менеджмента в систему предприятия.

**Ключевые слова:** инновационный менеджмент, малые предприятия, финансирование, принудительный метод, управление кризисной ситуацией, управление сопротивлением

**Summary.** The introduction of innovative educational programs based on a comprehensive study of market instruments as an important aspect in the formation of a competent understanding of the financial miasma of the entrepreneur is considered. The problems of innovation management are studied. New technologies and strategies for the introduction of innovation management in the enterprise system are presented.

**Keywords:** innovation management, small enterprises, financing, compulsory method, crisis management, resistance management.

UDC 338.242

## **RICHTUNGEN DER STAATLICHEN UNTERSTÜTZUNG DES SCHIFFBAUS**

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Der Schiffbau in Russland ist der wichtigste Zweig der Haustechnik, der etwa 200 Schiffbau- und Reparaturbetriebe, Schiffbau- und Instrumentenbaubetriebe vereint. Insgesamt beschäftigt die Branche mehr als 200 Tausend Menschen sowie Tausende kleiner Vertrags- und Lieferorganisationen. [1, s.55] Daher ist der Schiffbau eine sehr komplexe und spezifische Industrie, die eine große Anzahl verwandter Industrien bei der Herstellung von Produkten ansammelt und dadurch ihre Entwicklung und den technologischen Durchbruch der gesamten Industrie stimuliert.

Der Präsident der Rosspetsmash Association Konstantin Babkin nennt den Schiffbau (sowie den Flugzeugbau) die «Kategorie A» der russischen

Industrie. Laut Babkins Klassifizierung sollte diese Kategorie Branchen umfassen, die nur mit der Beteiligung des Staates konkurrieren können. «Das nennt man strategische Industrien, wissenschaftsintensive Industrien, Unternehmen, die eine komplexe Kooperation erfordern, sowie Unternehmen, die Investitionen mit einer langfristigen Amortisation und staatlichen Anstrengungen zur Förderung von Gütern benötigen» [2, s. 26].

Im Gegensatz zu anderen Ingenieurbranchen ist die Schiffbauindustrie mit der Schaffung sehr komplexer und relativ teurer Produkt verbunden. Zum Beispiel schwanken die Kosten für den Bau von Tankschiffen von \$10 Millionen. Ein Hauptmerkmal des Schiffbaus ist neben der Kapitalintensität die hohe Ausführungsdauer der vertraglichen Verpflichtungen - die Erstellungszeit beträgt durchschnittlich 20-30 Monate. Daraus folgt, dass die Frage des Preises eine wesentliche Rolle im Budget für den Bau jedes Schiffs sowie der Entwicklung der Industrie als Ganzes spielt. Daher wird in der Weltpraxis der Bau von Schiffen mit Hilfe von Bankkrediten durchgeführt, die vom Reeder für einen Zeitraum von 15-20 Jahren gegen Kautions im Eigentum der Gerichte oder unter den Garantien von kommerziellen und staatlichen Organisationen ausgestellt werden.

Russland ist heute die einzige Schiffbautruppe der Welt, die keine Maßnahmen zur Unterstützung des einheimischen Herstellers von Schiffs- und Flussausrüstung durchführt. Darüber hinaus trägt die Steuerpolitik in Russland nicht dazu bei, Bestellungen für inländische Werften zu sichern, sondern erhöht auch die Kosten des Schiffes um 20-30%, was die Kosten ähnlicher im Ausland gebauter Schiffe übersteigt. Die Steuerpolitik beraubt Schiffbauern einen erheblichen Anteil des Umlaufvermögens und zwingt die Fabriken, Kredite zu hohen Zinssätzen aufzunehmen, was wiederum zu einer Überschätzung der Baukosten für Schiffe führt.

Laut dem Verkehrsministerium in naher Zukunft in Russland sollten 320 Schiffe der Flussflotte gebaut werden, vor allem Schiffe der gemischten Navigation. Der Bedarf von Russland an Fischereifahrzeugen wird vom Fischereiausschuss in mehr als 550 großen und mittelgroßen Fischereifahrzeugen für verschiedene Zwecke und mehr als 500 kleinen kommerziellen Fischereifahrzeugen geschätzt. Die Gesamtkosten von etwa 2,5 Milliarden Dollar [3]. Die Analyse des russischen Marktes zeigt, dass inländische Schiffsbauwerke praktisch die gesamte Palette der erforderlichen Produkte bauen können, aber die technischen und finanziellen Möglichkeiten machen die Durchführung dieser Aufträge sehr schwierig und kostspielig.

Laut dem Föderalen Amt für See- und Binnenschifffahrt beträgt die Abschreibung der mechanischen Werkstätten der russischen Werften 85%, Gießereien - 75%, Docks - 65%. Das Problem besteht jedoch nicht darin,

dass die Ausrüstung ihre eigenen Ressourcen aufgebraucht hat, sondern dass es keine strategischen finanziellen Bedingungen für die Modernisierung der Branche als Ganzes gibt.

Der moderne zivile Schiffbau in den meisten Ländern der Welt nutzt in unterschiedlichem Maße staatliche Unterstützung, die sowohl aus strategischen als auch aus sozialen Gründen gewährt wird. Gleichzeitig führt der Zustand des russischen Schiffbaus dazu, dass russische Werften ohne Aufträge bleiben und Schiffbauer ohne Arbeit sind. Um die gegenwärtige Situation zu ändern, muss der Staat ein bestimmtes Maßnahmensystem einführen, das ein Element der protektionistischen Politik ist. Die meisten Länder der Welt verfolgen eine solche Politik hinsichtlich ihrer nationalen Industriezentren.

Die führenden Schiffbaumächte der Welt bieten ihren Betrieben eine ganze Reihe von Vorteilen in den folgenden Bereichen:

- Gewährung langfristiger staatlicher Garantien, die es den Werften ermöglichen, ihren Kunden einen Warenkredit von bis zu 15-20 Jahren zu gewähren;

- Gewährung staatlicher Garantien für inländische Lieferanten von Ausrüstung und Material;

- Gewährung staatlicher Garantien für die Rückzahlung von erhaltenen Vorauszahlungen für Schiffbauaufträge;

- Erstattung von Auslagen für Darlehen, die von Werften in Anspruch genommen werden, aus dem Staatshaushalt, während Schiffe für den Export gebaut werden;

- Programme der staatlichen Versicherung von Währungsrisiken auf Schiffbauverträgen [4, 5].

Als Beispiel für eine protektionistische Schiffbaupolitik kann das "Jones Law" in den USA genannt werden, wonach die Binnenschifffahrt auf Schiffen, die in US-Werften gebaut wurden und unter der US-Flagge schweben, in dem Land durchgeführt werden kann. Und 1993 wurde das Gesetz "Über die nationale Schiffsinitiative" verabschiedet, nach dem amerikanischen Reedern die Möglichkeit gegeben wurde, Schiffe auf US-Werften zu bauen und um Regierungsgarantien für das Darlehen in Höhe von 87,5% des Wertes des Schiffes in Tranchen für 25 Jahre zu erhalten. In Spanien gewährt die Regierung Bürgschaften für Kredite in Höhe von 85% des Wertes des Schiffes. Japan, Südkorea, Deutschland bietet nationale Subventionen von 30% der Kosten. Rechtlich konzipierte wirtschaftliche Maßnahmen zur Unterstützung des Schiffbaus in allen Ländern der Welt, mit Ausnahme der Russischen Föderation, zielen darauf ab, eine möglichst hohe Auslastung der nationalen Produktionen zu gewährleisten, indem Bestellungen mit den günstigsten wirtschaftlichen Vertragsbedingungen

angeboten werden.

Gleichzeitig ist der Haupttrend bei der Entwicklung von Formen staatlicher Hilfe der Übergang von der direkten Subventionierung zu flexiblen Formen der Unterstützung durch Kredit-, Steuer-, Schulden- und Zollpolitik. In diesem Zusammenhang wurde im Jahr 2011 das Gesetz Nr. 305-FZ «Über die Änderung bestimmter Gesetzgebungsakte der Russischen Föderation im Zusammenhang mit der Durchführung von Maßnahmen der staatlichen Unterstützung für den Schiffbau und die Schifffahrt» verabschiedet. Diesen Änderungen soll der inländische Schiffbau und die Schifffahrt unterstützt werden.

Das Gesetz enthält die folgenden grundlegenden Maßnahmen für die Instandhaltung des russischen Schiffbaus:

- Das russische Schiffsregister verbietet die Registrierung von Schiffen, die älter als 15 Jahre sind.
- Die Grundstücke und Grundstücke des Bewohners der Industrieproduktions-Sonderwirtschaftszonen (geregelt durch 116-FZ vom 22.07.2005), die für den Bau und die Reparatur von Schiffen notwendig sind, sind steuerfrei. Das Privileg gilt für 10 Jahre ab dem Zeitpunkt, an dem der Status eines Bewohners erlangt wird.
- Die Hauptaufgaben der Vnesheconombank bestehen in der Garantieunterstützung für Schiffbauorganisationen, die in Sonderwirtschaftszonen der Industrieproduktion ansässig sind.

Eine der Richtungen der staatlichen Unterstützung wird auch die Initiative der gesetzgebenden Versammlung der Leningrader Region sein. Die Leningrader Abgeordneten legten der Staatsduma einen Gesetzesentwurf vor, mit dem die Mehrwertsteuer für Unternehmen, die im Rahmen von Unteraufträgen Vereinbarungen über den Bau von Schiffen treffen, aufgehoben wird.

Das Bundesgesetz Nr. 488-FZ vom 31. Dezember 2014 «Über die Industriepolitik in der Russischen Föderation» sollte auch die staatliche Unterstützung bei der Entwicklung des Schiffbaus regeln. Das Gesetz enthüllte die Befugnisse der regionalen Behörden und der Regierung der Rußländischen Föderation in Fragen der industriellen Entwicklung und gab den Gebietskörperschaften erstmals in der Geschichte des modernen Rußlands die Möglichkeit, die industrielle Entwicklung der Gebiete zu beeinflussen und Industrieunternehmen zu unterstützen, die zunächst keine Fragen von lokaler Bedeutung behandelten.

Eine der Maßnahmen zur Steigerung der Wettbewerbsfähigkeit des Schiffbaus besteht darin, die Patentaktivität in der Industrie zu erhöhen und neue Technologien zu entwickeln. Gegenwärtig hat Russland ein Problem mit der Arbeit auf dem Gebiet des geistigen Eigentums. Bei

Schiffbauunternehmen wird die Notwendigkeit, ein wirksames Anreizsystem für Erfinder zu schaffen, unterschätzt. Aktivitäten auf dem Gebiet des geistigen Eigentums sind eher eine Belastung als eine Entwicklungsperspektive.

Eine Studie über die Erfahrungen fortgeschrittener innovativer Volkswirtschaften der Welt zeigt, dass Industrieländer auf dem Gebiet der Patentierung von Ergebnissen des geistigen Eigentums zentrale Mechanismen der staatlichen Unterstützung nutzen (Gewährung von Forschungszuschüssen und -gebühren in Hongkong, Erstattung von Gebühren und Abgaben in Singapur), individuell orientierte materielle Anreize, soziale und arbeitsrechtliche Vorteile für Erfinder (Japan, Südkorea, China), Steueranreize für innovative Organisationen und Verbraucherunternehmen.

Eines der wirksamsten Instrumente, um die Nachfrage nach Innovation zu erhöhen und die Nutzung von Ergebnissen intellektueller Aktivität zu stimulieren, sowie die Aktivität der geschäftlichen Interaktion zu erhöhen, ist ein innovativer Gutschein. Das Innovationszertifikat (Voucher) ist eine vom Staat ausgestellte Sicherheit mit staatlich garantierter Sicherheit für die Bezahlung von Forschungs- oder Beratungsleistungen externer Organisationen für die Bedürfnisse eines bestimmten Kundenunternehmens.

Die Umsetzung einer Reihe von Maßnahmen zur Unterstützung von Erfindungen als treibende Kraft der innovativen Entwicklung des Unternehmens wird die Patentaktivität von wissenschaftlichen Einrichtungen und kommerziellen Organisationen erhöhen, was wiederum zu Veränderungen in der technologischen Ordnung führen wird.

Alle diese Rechtsvorschriften sowie die Schaffung einer Sonderwirtschaftszone auf der Krim sollten die beschleunigte Entwicklung der Schiffbauindustrie auf der Halbinsel beeinträchtigen. Die Regierung der Republik Krim, die Kommunen sollen die Arbeit an der Vorbereitung der Dokumentation für die Bildung der speziellen Wirtschaftszone für die Realisierung 305-FZ beginnen. Ich bin zuversichtlich, dass die Spezialisten der Schiffbau- und Schiffsreparaturwerke mit allen möglichen Unterstützungen versorgt werden. Das Verfahren zur Registrierung einer freien Wirtschaftszone ist nicht einfach. Da das Konzept auf 49 Jahre ausgelegt ist, werden Experten das wirtschaftliche Potenzial der Region im Schiffbau fast ein halbes Jahrhundert voraus berechnen. Unter den geplanten Ergebnissen wird sich jedoch neben der Umsatzsteigerung auch die Zahl der Beschäftigten in der Schiffbauindustrie in der Region durch die Schaffung der SEZ für den Schiffbau erhöhen. Im Einklang mit den Zuständigkeiten der kommunalen und staatlichen Stellen sollten Sachverständige der Regierung der Krim und der lokalen



Gebietskörperschaften, die Federal Property Management Agency, der Steuerdienst und die Entwicklungsbank aufgefordert werden, an der Schaffung einer Sonderwirtschaftszone zu arbeiten.

Dank all dessen kann in naher Zukunft ein Konzept für die Entwicklung der Wirtschaftszone für den Schiffbau vorbereitet werden, was die Region Krim zu einem der führenden Unternehmen der russischen Schiffbauindustrie machen und große Aufträge im Bereich des zivilen Schiffbaus anziehen wird.

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**Аннотация.** В статье рассматриваются основные направления государственной политики по развитию судостроительной промышленности, отмечается минимальный уровень протекционизма в России в сравнении с другими судостроительными державами мира. Отмечаем необходимость использования стратегических правовых актов в области поддержки судостроения и судоходства для развития судостроения на территории крымского региона. Отдельно рассматриваются предложения по инновационному развитию предприятий отрасли.

**Ключевые слова:** судостроительная промышленность, судоремонт, промышленная политика, инновационное развитие, протекционизм.

**Summary.** Der Artikel untersucht die Hauptrichtungen der staatlichen Politik für die Entwicklung der Schiffbauindustrie und stellt fest, dass der Protektionismus in Russland im Vergleich zu anderen Schiffbaumächten in der Welt minimal ist. Wir weisen auf die Notwendigkeit hin, strategische Rechtsakte im Bereich der Schiffbau- und Schifffahrtsunterstützung für die

Entwicklung des Schiffbaus in der Krim zu verwenden. Die Vorschläge zur innovativen Entwicklung der Unternehmen der Branche werden getrennt betrachtet.

**Keywords:** Schiffbauindustrie, Schiffsreparatur, Industriepolitik, innovative Entwicklung, Protektionismus.

UDC 336.22

## **PENSION SYSTEM OF THE RUSSIAN FEDERATION: KEY CHALLENGES AND SOLUTIONS**

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The urgency of the study of pension provision issues is conditioned by the need to achieve the goals, goals and guidelines for modernizing the Russian economy, ensuring its growth, improving the quality of life of the Russian population, which are impossible in the President's Addresses, state programs, concepts and other normative acts, which is impossible without a socially oriented and fair fiscal policy. At the same time, one of the key areas is a fair and scientifically based pension system based on constitutional foundations, accumulated Russian and foreign experience.

The need for a comprehensive solution of "pension problems" was very correctly noted by Napalkova M.O. and Susljakova O.N. [1] In turn, Goncharova M.V. and Goncharov A.I. considered the development of the financial and legal regime of pension provision in the Russian Federation [2].

It is also necessary to agree with N.S. Sergienko who noted the need to assess financial risks [3] and the importance of state financial control [4, p.59], which is especially important in the context of the influence of uncertainties on the formation of budget revenues of the budgetary system of the Russian Federation [5, 6] and the development of a strategy for economic security of the Russian Federation [7]. In this context, it should be noted that there is an opportunity to improve the efficiency of budget expenditures through the formation of a monitoring system [8].

Shestakova E.E. assesses the modern Russian pension system as a tool to combat poverty [9, p.113-114]. In turn, Rybintseva E.V., considering the financial basis of the citizens' right to social security in Russia, linked the size of the pension with the minimum wage [10]. However, we should disagree with the author about the use of the minimum wage in calculating a pension, which finds absolutely no application in the process of calculating

a pension (not only for the new pension formula, but also for the old pension scheme in force until 01.01.2015 ). Moreover, Soliannikova S.P. rightly emphasizes the need to match the results of activities in the social sphere to the goals and objectives [11].

Despite the steps taken and the changes made, a significant part of the problems remained unsolved:

1. At the present time, one of the most acute is the discussion on the need to increase the retirement age in the Russian Federation. In this case, it is important to note a few points:

A) The current retirement age in the Russian Federation was established 85 more years ago, which is totally inconsistent with the current realities (including the significantly increased life expectancy and activity of the population at the current age for retirement).

B) Article 19 of the Constitution of the Russian Federation establishes equality of the rights of citizens, regardless of gender.

C) In the overwhelming majority of countries (including in the leading countries of the Global AgeWatch Index 2015), the retirement age is higher than that established in the Russian Federation and is the same for men and women.

2. All citizens receive a social pension, regardless of the availability of insurance experience. For example, a person who does not have insurance experience (and, correspondingly, for which not a single ruble of contributions was paid), but who reached the age of 60 (for women) and 65 (for men) is entitled to a social old-age pension (moreover , in the absence of income (which is concomitant in the vast majority of cases), and then bringing its value to the minimum subsistence level in the region through regional / federal social subsidies). At the same time, when making this decision, absolutely no other factors are assessed - for example, the availability of expensive real estate or other property.

3. Mistrust of Russian citizens to the activities of non-state pension funds, which makes it difficult to develop a funded pension and non-government pension provision.

4. The lack of sufficient knowledge among the population about the procedure for the formation of pension rights and the calculation of insurance pensions, as well as on funded pensions and non-state pension provision.

5. Inadequate validity for the calculation of points for socially significant periods (for example, in the care of the third and fourth child, the same number of points is awarded, and starting from the fifth, there is no accrual at all).

6. Discussion continues on the one hand, on the one hand, the abolition

of the early appointment of pensions, and on the other hand, the improvement of the quality of education and health (which, of course, requires careful treatment of the relevant categories of citizens), as well as the development of agriculture (but, at the same time, norms for increasing the fixed payment to insurance pensions for old age and disability by 25% for citizens who have worked at least 30 years in agriculture and continue to live in rural areas).

7. Accumulation pensions and non-state pension provision are not developed enough.

At the same time, pension reform should be carried out in 2 stages.

So, at stage 1 (from 2019 to 2035) it seems expedient to implement the following set of measures:

1. Change in the conditions for assigning a social pension for old age.

2. With a view to encouraging citizens to work legally, to cancel regional and federal social subsidies to old-age social pensions for citizens who have not fulfilled the minimum number of years of insurance for an insurance pension.

3. Bringing age for retirement in accordance with the realities, incl. the value of the current life expectancy and activity of citizens, and also taking into account the provision of constitutionally guaranteed equality of citizens' rights, regardless of gender.

4. An increase in the minimum period of insurance for obtaining an old-age insurance pension for up to 20 years (by continuing to implement the decision to increase annually for 1 year - until 2024, maintaining a minimum of 15 years in 2025 and then increasing from 2026 annually to 6 years months until 2035).

5. To increase the role and importance of non-state pension funds by moving to the exclusively voluntary formation of a funded pension with the participation of working citizens, employers and the state.

6. Notwithstanding the adjustment of the retirement age, allow citizens to be granted a funded pension at 55 (women) and 60 (men).

7. Annual adjustment of the minimum retirement age for professional categories of persons entitled to early retirement. Moreover, during the first stage (no later than 2025), it is necessary to develop:

- the procedure for changing the minimum period of insurance for the appointment of an early pension for each of the professional categories of persons;

- a special scheme for adjusting the minimum retirement age and length of service for social categories of persons entitled to early retirement.

8. Expansion of the period of differentiation of the size of the coefficients for a later retirement to the age of 20 (currently, such

coefficients for retirement in the age group are set only up to 10 years). However, in the case of a later retirement, it seems fair to use these coefficients, regardless of the availability of the right to early appointment (at present, if this right is available, lower coefficients are used).

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**Аннотация.** В статье представлены результаты проведенного исследования проблемы развития модернизации пенсионного обеспечения в Российской Федерации в современных социально-экономических условиях. Особое внимание автором уделено выделению ключевых вызовов пенсионной модернизации и возможным путям решения существующих проблем. Так, в частности, автором предлагается осуществление не точечных корректировок и параметров пенсионной системы, а комплексная пенсионная реформа в 2 этапа: с 2019 по 2035 гг., 2036-2052 гг.

**Ключевые слова:** пенсионная система, пенсии, пенсионный возраст, социальные расходы

**Summary.** The article presents the results of the conducted research of the problem of the development of pension security modernization in the Russian Federation in the current socio-economic conditions. The author pays special attention to identifying the key challenges of pension modernization and possible ways of solving existing problems. Thus, in particular, the author proposes the implementation of non-point corrections and parameters of the pension system, and complex pension reform in 2 stages: from 2019 to 2035, 2036-2052.

**Keywords:** pension system, pensions, retirement age, social expenses

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## **OIL-EXTRACTING INDUSTRY OF THE NEAR EAST COUNTRIES IN THE WORLD POWER MARKET SYSTEM**

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Considerable resources of hydrocarbon raw material, including oils, a strategic geographical location have determined an important role of the Arabic countries in a global economy. Questions, related to the study of competitiveness of oil-processing industry of Near East countries have a complex character, include, foremost, the analysis of basic factors of competitiveness of oil-extracting industry, the efficiency of the use of oil companies strategies on national and world markets.

The problems of oil market functioning in Near East in terms of globalization, geopolitical challenges, development of competitiveness of its oil-extracting industry predetermine the actuality of selected theme.

*The research goal* is to analyse the role and place of oil-extracting industry of Near East countries in the system of world energetic market.

As a term the «Arabic world» in scientific literature has an ambiguous interpretation, in-process we adhere to the point of view of Y. Selyanina, who supposes that under the «Arabic world» it is accepted to imply 18 independent states located on Near East and in North Africa, they are: Algeria, Bahrain, Egypt, Jordan, Iraq, Yemen, Qatar, Kuwait, Ливан, Libya, Mauritania, Morocco, UAE, Oman, Saudi Arabia, Syria, Sudan, Tunis and Palestinian Autonomy» [6].

A geographical closeness and presence of general borders are the major factors of different economic connections development. Community of language simplifies a communication and mutual collaboration. A powerful factor uniting the Arabic countries is an Islam. Likeness of the Arabic countries to a great extent is determined by uneconomic parameters.

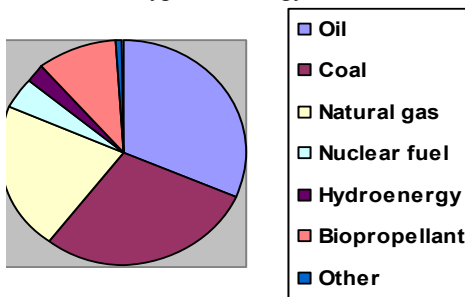
The entire Arabic countries behave to the developing states. The Arabic countries are characterized by a substantial difference in the level of economic and social development, comparatively by weak diversification of economy. The process of modernisation in the most Arabic countries passed rapid enough rates. The differences and features, determined by the attained level of socio-economic development, have changes each country [6]. Different reforms rendered on the whole the positive influence on the dynamics of Arabic countries economic indicators, however a decision factor was a return of the favourable price to the state of affairs for Arabic oil exporters.

A world economic crisis brought the correctives in the development of every Arabic state. Thus the degree of influence on one or another economy of region is varied largely. The most considerable shocks touched the most Arabic countries in 2009 in connection with the decline of world oil prices to the level 40 dollars for a barrel.

It was assumed that with an increase in demand for energy resources, the growth rate of GDP of the Arabic oil exporting states attained in 2011 on the average 4,5%. The rates of height of other Arabic economies in 2009-2010 had a tendency to the gradual increase in connection with the revival of trade relationships with countries of EU and USA. However, events in 2011 and difficult current situation in these countries called a lot of prognoses under discussion [6, p.11].

In terms of globalization a world power market is an indivisible, organically interconnected complex of markets of commodities, services, technologies in productive sphere, financial resources, information and shots, bounded by co-operation of countries, international and national companies of power sector [1, c.13].

The general volume of demand on the world power market by types of fuel is represented on the picture 1. The stake of oil makes 31,30%, coal – 28,60%, natural gas – 21,20%, nuclear fuel – 4,80%, hydroenergy – 2,40%, biopropellant – 10,30%, other types of energy resources – 1,0%.



Pict. 1. The general volume of demand on the world power market by types of fuel in 2016.

Source: It is made by author on the basis of IEA data [12].

Oil has certain natural advantages under a hard fuel, including: large power efficiency on unit of volume and weight; property of fluidity, that facilitates the mechanization and automation of booty, transporting, loading, processing; relative cheapness of transportations on the liquid courts of large carrying capacity [2, p.6].

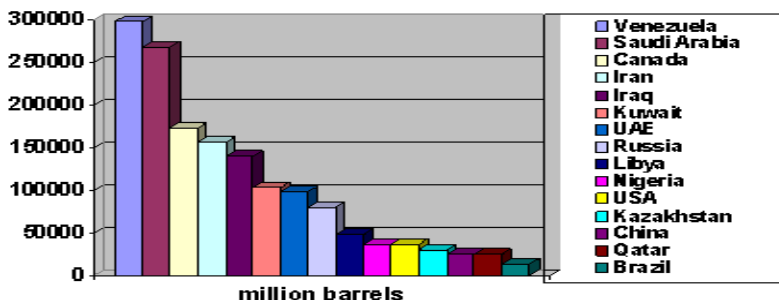
The greater part of world resources of oil are concentrated in developing countries, first of all in the countries of Near and Middle East (about 56%). The half of petroleum riches of planet is concentrated in the giant deposits of the Arabian peninsula. Petroleum industry in these countries is highly monopolized [2, p.6].

Presently in the whole world there is a 101 country with well-proven oil-fields. The general world well-proven of oil-fields make 1 481 526 million barrels [5].

On a picture 2 we can see the rate of countries, possessing the most of oil-fields (well-proven): Venezuela takes the first place – 297 740 million barrels, further Saudi Arabia – 268 350 million barrels, Canada – 173 625-175 200 million barrels.

Also Iran, Iraq, Kuwait, OАЭ, Russia, Libya and Nigeria are among 10 largest word oil-supplies countries. Russia is on a 8 place in this list with supplies 80 000 million barrels (pict. 2).



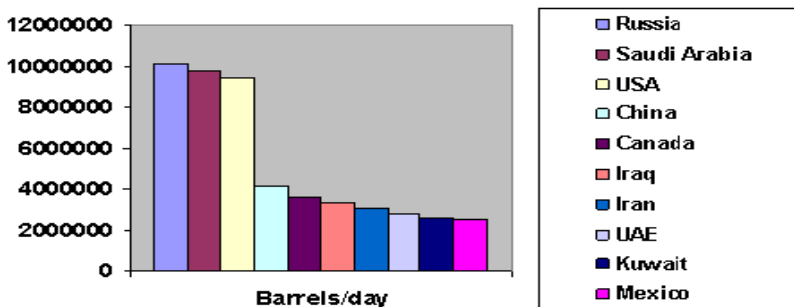


Pict. 2. Leading countries by the number of oil fields (million barrels).

Source: It is made by author on the basis of IEA data [12]

Russia is on the first place in oil extraction in the world with an index 10 107 000 barrels per day. The second place takes Saudi Arabia – 9 735 200 barrels/day. The third place in oil extraction occupies the USA – 9 373 000 barrels/day. The general volume of world oil extraction makes 84 951 200 barrels in a day [11].

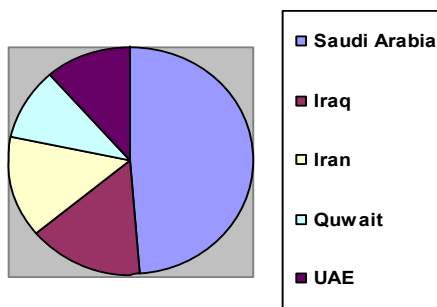
Oil is the largest sector of world economy in volume and costs of contracts. Already now, according to the IEA 2016 report, oil extraction outruns the consumption approximately in 2 times [10].



Pict. 3. Leading countries in oil extraction (barrels/day)

Source: It is made by author on the basis of IEA data [12]

In 2016 rating five from ten leading oil producing countries were located on Near East: Saudi Arabia, Iran, Iraq, Kuwait and UAE. This group of countries makes one-fourth of the world's oil production (pict. 4) [10].



Pict. 4. Leading oil producing countries in the Near east.

Source: It is made by author on the basis of IEA data [12]

According to the last report of the International Energy Agency, the daily oil extracting made by OPEC members is about 36,89 million barrels. The report data testify that Near East region plays the key role on international market of raw material [12].

As a result of correlation of demand and supply the long-term tendency of the oil prices dynamics is set in the world market of oil, and in the short-term prospect their volatility is determined by progress of market segment trends exchange. The question is that the last years petroleum derivatives became the very attractive field for financial speculations, therefore petroleum quotations in separate periods of the last years are unstable [9].

The activity of financial institutions distorts market pricing in the world oil market, the price of which increasingly depends not on the fundamental factors, but on the behavior of operators in the exchange market [8]. Thus, during the crisis, the spasmodic price dynamics is explained in the literature precisely by the dynamics of speculative turnover [3, p.58].

A stable opinion has developed in the scientific thought of the modern world, that in fact, the world oil market was transformed from the physical to the financial (that is, trading in options and futures contracts for the supply of oil instead of trading in crude oil).

Forming of a new model of world market, with differentiation of various exchange and unexchange instruments, it is necessary to take into account the estimation of demand on oil as available commodity, that it is important from the point of view of research of world oil production segment [7].

The main regularities of the present-day development of the world oil market are:

1. *Gradual concentration of oil production in the territory of developing countries.* Before the Second World War, more than 4/5 of the world oil production accounted for the countries of the Western Hemisphere, mainly the United States and Venezuela, which were the leading suppliers of oil to the world market. Today, the main oil producers are Russia, Saudi Arabia, the United States of America, Iran, China, Mexico, which together account for 47% of world production.

2. *Change in the geography of world oil reserves* in favor of the Near East and Canada (including oil sands), which control more than 60% of all the world proven oil reserves. The main feature of the geography of the world's oil resources at the present time is that most of them fall to the share of developing countries, especially the Near and Middle East. At the same time, the high price conjuncture of the world oil market led to the inclusion of unconventional sources of petroleum products into the category of proven oil reserves - the oil sands of Canada.

3. *Increase in the volatility of oil prices and their rapid growth beginning of the XXI century.*

4. *Concentration, centralization of production and capital in the oil industry.* In the context of the aggravation of the struggle for access to energy resources, transport and sales infrastructure, companies resort to mergers and acquisitions, considering them as a key factor of competitiveness.

5. *Strengthening the positions of state oil companies in the world oil market.* The concentration of oil reserves in the territory of developing countries, the price conjuncture of the world oil market led to an increase in the share of state companies in world oil production. The consequence of these processes has become a complication of the firm structure of the world oil market, the number of full-fledged players of which included companies with state participation in the share capital [4, p.16].

As we can see, the oil-producing industry of the Near East countries takes the leading place in the system of the world energy market. The main trends of the world oil market in the last decade are as follows: strengthening the role of the state in the economic activities of the world oil industry; integration processes in the segment of the world largest private oil companies; activation of public-private partnership; increasing the resource efficiency of state oil companies; strengthening the competitive position of state oil companies in the world oil market.

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**Аннотация.** В статье рассматриваются роль и место нефтедобывающей промышленности стран Ближнего Востока в системе мирового энергетического рынка. Анализируются проблемы функционирования рынка нефти Ближнего Востока в условиях глобализации, геополитических вызовов, развития конкурентоспособности его нефтедобывающей промышленности. Представлена динамика развития современного мирового рынка нефти. Охарактеризованы основные закономерности современного развития мирового рынка нефти.

**Ключевые слова:** Ближний Восток, нефть, нефтедобывающая промышленность, мировой энергетический рынок.

**Summary.** The paper reveals a role and place of the oil-extracting industry of the Near East countries in the world power market system. The problems of functioning of the Near East oil market in terms of globalization, geopolitical challenges, development of its oil-extracting industry competitiveness are under analyses. The development dynamics of the world oil market has been presented. The contemporary world oil market basic conformities have been described.

**Keywords:** Near East, oil, oil-extracting industry, world power market.

UDC 336.67

## **PERSONNEL POLICY IN THE SYSTEM OF STATE POWER**

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The vitality of any country and any civilized state depends to a large extent on the efficiency and quality of the public administration system and government bodies. This also applies to the system of public administration in the Russian Federation, which currently passes through a complex path of

social, economic and political reforms. Undoubtedly, without qualitative and effective professional service in the sphere of state administration and authorities it is difficult to talk about any notable achievements of the modernization of our society [1, p. 68].

The development of the system of public administration in our country takes place in crisis situations and phenomena related to the economy and the financial sphere and it is accompanied by limited resources. Therefore, personnel policy in state bodies becomes an extremely important and necessary means for effective application and optimization of available resources [2, p. 84].

Scientists note that of all the available resources of the state, (financial natural, material), human resources, that is, human resources are the most significant. This is evidenced by historical experience. In fact, one resource manages both financial, natural and material resources, influences the course of socioeconomic, political and socio-cultural development, and determines the degree of progressiveness and dynamism of the qualitative state and development of all subsystems of society and the state. This resource, the so-called human capital, plays a leading role in improving the efficiency of state administration of the country. Personnel processes manifest themselves in all spheres of the life activity of society and the state [3, p. 23].

According to expert opinion, many specialists in the field of personnel policy theory, social and economic efficiency in any field of activity depends only on people - the staff and their professionalism. Indeed, "cadres decide everything". We all know this winged expression, authored by the famous statesman of the times of the Soviet Union, Joseph Vissarionovich Stalin. This phrase he said back in 1935 during a report on the state of affairs in the USSR. The essence of this phrase is to draw attention to the role and importance of the system of education, education, upbringing, development and professional skills of modern man in the approach to solving urgent problems of society and the state. Undoubtedly, this is really so, because depending on the competence and professionalism of one or another specialist, the social and economic effectiveness of the organization depends [4, p. 75].

Certainly, properly selected personnel, who are called upon to implement some creative ideas, have a significant influence on their implementation. It is for this reason that various enterprises, institutions and companies want to have the most qualified personnel, including in the public administration system, and in the government. The creation and application of the personnel policy of our state is a multilateral and complex process that begins with the identification of its conceptual and theoretical

foundations. The definition of theoretical concepts, purposes and nature allows to define tasks, goals, principles, priorities, peculiarities, mechanisms and technologies of application and development of personnel policy in public authorities.

At present, unfortunately, despite the numerous efforts to develop the theoretical directions of the state personnel policy of the Russian Federation (strategy for the formation, qualitative development and effective use of personnel in the public administration system, etc.), there is unfortunately no general approved concept of state personnel policy. At the same time, the conceptual bases of the currently implemented state personnel policy really exist and are working.

Personnel policy provides a system of principles, theoretical knowledge, relations and organizational and practical activities of non-state organizations, government bodies and public administration system aimed at the specific definition of tasks, objectives, the nature of this policy, the definition of methods and forms of personnel work.

State personnel policy is a strategy for the work of the public administration system with cadres at the regional and federal levels. This strategy is aimed at the formation, development and effective use of the country's labor resources, its human resources.

The main purpose of personnel policy in public authorities is its focus on the formation of social progress and other priorities in public activities. One of its main objectives is the effective use of the country's labor resources, the creation of creative labor collectives, the formation of those favorable conditions and a socio-psychological atmosphere that would contribute to their full and effective development. Personnel policy covers a set of political, socio-economic and socio-cultural tasks. The fulfillment of the above tasks is carried out on the basis of the legal system and is carried out mainly in three areas:

- in the field of state organizations, institutions and enterprises;
- within the framework of the civil service at the appropriate levels: at the level of local government, at the level of the subjects of the federation and at the federal level;
- in the field of non-state enterprises (firms, companies, joint-stock, private, lease, etc.) [7, p. 110].

It should be noted that the modern staffing policy in public authorities is developed and applied at different levels.

At the federal level, this is a certain and precise work of the system of federal executive bodies. And at the regional level, the development and effective use of the personnel policy of the system of executive authorities of certain subjects of the Russian Federation. Through the application of

legislative acts, the system of training highly qualified personnel, state control, it also exerts a significant influence on the personnel policy of municipal authorities and other organizations, enterprises and institutions.

In the author's opinion, an effective personnel policy in government bodies can be formed and used successfully, taking into account the objective cycle of the generation change and the constant rotation of personnel. The duration of the cycle of changing the generation of cadres of a new type can be 10-15 years. This is a sufficient period for the formation of highly professional and strategically thinking employees in the system of public administration in our country.

The structural component of the personnel policy in the bodies of state power has its own peculiarity. It is like a system, and as a holistic phenomenon has a certain structure into which the following components can be included: [9, p. 86].

- officially approved goals and major tasks for timely and quality maintenance of the public administration system of competent and professional personnel;

- conceptual programs for the effective provision of relevant cadres of the cultural, social, economic and political spheres of society;

- specific methods, methods, forms of implementation of personnel policy in various spheres and levels;

- competently developed qualification requirements for specialists of different levels as objects of personnel policy, depending on what functions and positions, these personnel will perform;

- educational, scientific and methodical plans and activities to consistently and systematically improve the competence and professionalism of cadres of different categories and levels, systematic career development to increase the effectiveness of public administration employees and authorities;

- a conceptual system for the continuous formation, training and development of cadres, which includes various methods and forms of improving their qualification level, training and retraining, an internship abroad to study foreign experience;

- the ways and forms of effective application of the personnel potential of the whole country.

Today, the development of an effective doctrine of personnel work and its implementation is a priority task of our state. It is for this reason that the study of the personnel policy and the ways of its implementation in public authorities is extremely relevant. Despite the fact that today in our country there are serious changes in the sphere of public administration, new principles and requirements are being developed for the activities of



representatives of the public administration system, relevant changes are made to labor legislation, etc., modern personnel policy is not able to provide effective search, recruitment, selection and selection of such employees in government bodies, which would largely correspond to modern moral, economic and socio-political requirements.

At the present time, the modern personnel policy of public authorities should take into account the main trends with the creation of a mechanism for managing labor resources at all enterprises, organizations and institutions of our country. This policy should develop the basic strategies of activity with the modern generations of cadres of the 21st century, create optimal conditions for their work, form, develop and rationalize their creative capabilities and managerial potential.

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**Аннотация.** В статье раскрываются место и роль кадровой политики в деятельности органов государственной власти, как важнейшего инструмента для эффективного применения и оптимизации имеющихся ресурсов. Рассмотрены основное предназначение, главные цели и направления кадровой политики на разных уровнях органов государственной власти как многосторонний и сложный процесс.

**Ключевые слова:** государство, органы власти, социальная политика, кадровая политика, организация, персонал органов власти, кадры, ресурсы, цели, принципы, проблемы, структура кадровой политики.

**Summary.** The article reveals the place and role of personnel policy in the activities of public authorities as an important tool for effective application and optimization of available resources. The main purpose, main goals and directions of the personnel policy at different levels of government bodies are considered as a multilateral and complex process.

**Keywords:** state, authorities, social policy, personnel policy, organization, personnel of authorities, personnel, resources, goals, principles, problems, the structure of personnel policy.

UDC 336.1

**OFFICIAL WEBSITES IMPROVEMENT OF FEDERAL PUBLIC  
FINANCE MANAGEMENT BODIES  
(BASED ON AUTHOR'S METHODOLOGY)**

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The relevance of the topic is due to the active development of information technologies and digitalization of the economy, which certainly has a serious impact on the management of public finances. At the same time, the availability of an open information resource that fully discloses information about the activities of the relevant public authority plays a fairly important role.

Due to the active introduction of information technologies and the penetration of the Internet, it is important to evaluate the official websites of public financial management at the Federal level. Thus, the study was conducted on the example of the Ministry of Finance of the Russian Federation, the Federal Treasury, the Pension Fund of the Russian Federation, the social insurance Fund of the Russian Federation, the Federal compulsory medical insurance Fund of the Russian Federation and the accounts chamber of the Russian Federation.

At the same time, a review of the scientific literature shows on the one hand the presence of attention to the analysis of efficiency of activity of bodies of state power and local self-government [1-3], on the other hand - the lack of methods of assessment of official websites of bodies of management of public finances. In this regard, in order to solve this problem, an attempt was made to propose the author's evaluation methodology, which will help both the above authorities at the Federal level, and subsequently, at the regional and local levels.

Thus, the method of evaluation proposed by the author is based on the use of a number of indicators on three key criteria: interface, content, feedback, in the context of each selected several items to be compared (Figure 1).

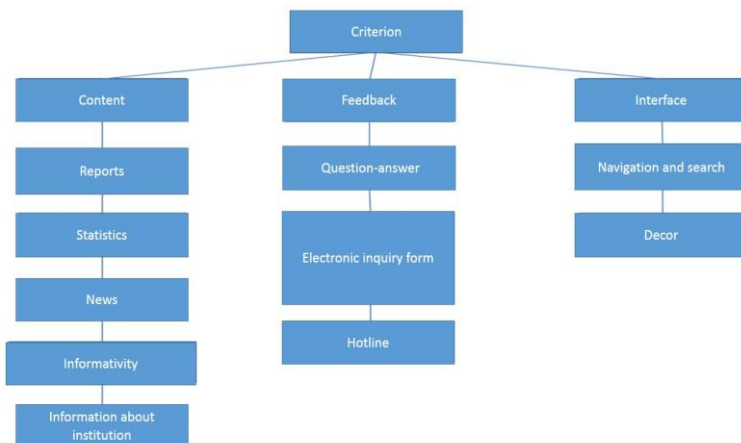


Figure 1. Evaluation criteria of official websites of public Finance management bodies at the federal level

Source: proposed by the author

The assessment should be carried out in stages:

Step 1. Conformity assessment of the site each element of the criteria (e.g., a scale).

Step 2. Evaluation of each criterion based on the evaluation of the element

Step 3. Correction of the received estimates of criteria taking into account specific weights.

Step 4. The summation of the obtained adjusted estimates

For example, each indicator is rated on a ten-point scale, then the average value is calculated for each of the three main criteria. At the next stage, the final value is calculated by adjusting the result taking into account the specific weights (determined by the author on the basis of importance from the position of public Finance management: content – 0.55, feedback – 0.30, interface – 0.15).

$R = C \cdot 0.55 + F \cdot 0.3 + I \cdot 0.15$ , where

R – the final grade of the site of public finance management bodies at the federal level

C-content rating on a ten-point scale

F-score of feedback on a ten-point scale

I-evaluation of the interface on a ten-point scale

As a result of the analysis, the following estimates were obtained, presented in figure 2. It is also worth noting the average rating of each of the criteria: content – 6,49, the presence of feedback – 5,679, interface – 5,286. It follows from this that the majority of shortcomings in the official

websites of public financial management at the Federal level is in terms of interface. Therefore, an overall recommendation for all bodies involved in this evaluation is to improve the interface of the official sites.

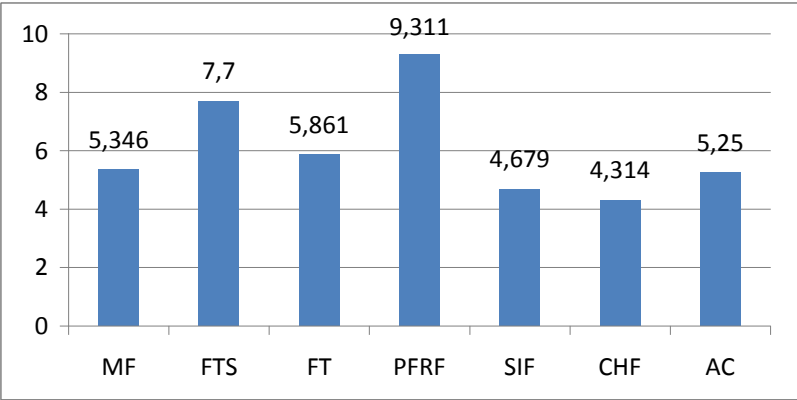


Figure 2. Assessment of sites of authorities of the public financial management.

Source: compiled and calculated on the basis of practical implementation of the method proposed by the author (based on information from official websites [4-9]).

It should be noted that one of the key elements of the assessment is also the transparency of the material on the sites, especially in budgets. The fiscal transparency Figure 2 focuses on ensuring the quality of data, as well as making informed decisions on the implementation of economic policy.

Moreover, the Ministry of Finance of the Russian Federation recommended to improve the FAQ section, add hot line and personal account of a citizen, the Federal tax service is to improve the color scheme of the website and increase the section "question-answer", the Federal Treasury – add a hot line for quick communication of citizens and officials of the public authority and form a partition of situations, the Pension Fund of the Russian Federation – improve navigation on the site and improve the efficiency of the use of space on the pages of the site, the social insurance Fund – to adjust the interface in terms of improving the search for the necessary information, add active hyperlinks and multimedia materials, the Federal social insurance Fund - to improve the interface of the site, as well as to accelerate the publication of news on the site, the accounts Chamber of the Russian Federation - more efficient use of space on the site, increase the number of frequently asked questions

Thus, the results of this rating give an idea of how and how effectively the websites of public Finance management bodies of the Federal level

operate. Moreover, the advantages and disadvantages identified through this methodology can also be used for newly created bodies, as well as Federal and regional financial authorities. The results obtained can also be useful for the Government of the Russian Federation in the framework of a comprehensive assessment of the activities of Federal Executive bodies, as well as the expert-analytical community.

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**Аннотация:** В статье рассмотрены сайты органов государственного управления, отвечающие за управление общественными финансами на федеральном уровне. Предлагаемая автором методика оценки базируется на использовании ряда показателей по трем ключевым критериям: интерфейс, контент, обратная связь, в разрезе каждого выделены несколько сравниваемых элементов. Полученные результаты могут быть полезны для Правительства Российской Федерации в рамках комплексной оценки

деятельности федеральных органов исполнительной власти, а также экспертно-аналитическим сообществом

**Ключевые слова:** управление общественными финансами, цифровизация экономики, электронные сервисы, общественные финансы

**Summary.** The article deals with the websites of federal public finance management bodies. The author's methodology of evaluation proposed by the author is based on the use of a number of indicators on three key criteria: interface, content, feedback, in the context of each selected several items to be compared. The results obtained can be useful for the Government of the Russian Federation in the framework of a comprehensive assessment of the activities of federal executive bodies, as well as the expert-analytical community.

**Keywords:** public finance management, digitalization of the economy, electronic services, public finance

UDC 338.2

## **DEVELOPMENT OF THE FOOD INDUSTRY ENTERPRISE STRATEGY BASED ON SWOT AND PEST ANALYSIS ON THE EXAMPLE OF «KING-BREAD» LLC**

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To date, the practice of doing business has made it clear that there are no such strategies that would be applicable to all organizations, nor is there a single universal for firms of strategic management. Any, even micro-organization, is unique, that's why the process of development strategy development for each such company is unique, because it depends on many different factors. For example, from the position of the enterprise in the market, the dynamics of its development, the use of competitors, the products or services provided and their characteristics, the position of the economy in the region, social and cultural environments, etc. Nevertheless,

there are some basic factors that allow us to assert the existence of generalized principles of strategic management.

If we talk about the food industry, there are specific features of this industry. The food market has a high capacity and a fairly stable demand, which allows enterprises to attract objects for investment. However, here there is a problem of competition, which leads to the need to develop certain strategies for enterprise development [1].

«King-bread» LLC was used SWOT-analysis [2]. The results are shown in Table 1.

Table 1 – SWOT- analysis

Strengths sides	Weak sides
<ul style="list-style-type: none"> <li>- the presence of a strong brand, the position of a leader in the market;</li> <li>- reputation of the manufacturer of quality products;</li> <li>- availability of qualified specialists in the organizational structure;</li> <li>- availability of a large assortment of products that are in demand;</li> <li>- use of modern accounting system - 1C Enterprise;</li> <li>- own accumulated database;</li> <li>- the ability to flexibly change the financial system;</li> <li>- financial support of the state;</li> <li>- availability of a system for training personnel.</li> </ul>	<ul style="list-style-type: none"> <li>- lack of active advertising activities;</li> <li>- lack of the necessary level of automation of the accounting system;</li> <li>- lack of highly qualified specialists;</li> <li>- few innovative implementations in production;</li> <li>- dependence on suppliers;</li> <li>- dependence on the outsourcing company to maintain the accounting system;</li> <li>- obsolete technologies for accounting and calculation of production costs;</li> <li>- lack of a budgeting system;</li> <li>- lack of a long-term business development strategy.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>- growth of retail and wholesale trade turnover;</li> <li>- growth in the turnover of public catering;</li> <li>- the possibility of receiving cash for the implementation of a new financial accounting system;</li> <li>- introduction of a budgeting system;</li> <li>- implementation of a financial risk control system;</li> <li>- development of a medium-term development strategy 1-3 years.</li> </ul>	<ul style="list-style-type: none"> <li>- deterioration of the financial position of the enterprise;</li> <li>- growth of duties on imported raw materials for production;</li> <li>- retraining of long-time employees;</li> <li>- the absence of a working group for the introduction of new projects at the enterprise;</li> <li>- the high cost of implementing a new system of accounting and financial planning.</li> </ul>



Analyzing the data presented in Table 1, one can say that along with the low risks of introducing a new system of financial control and planning, there are huge opportunities for obtaining a high effect on the implementation of the planned changes.

«King-bread» LLC produces products of a large assortment, which is in demand, and also has the position of a leader in the market, thanks to the reputation of the manufacturer of quality products. The enterprise uses a modern accounting system - 1C Enterprise and its own developed database of both suppliers and customers. Financial support of the state of «King-bread» LLC, undoubtedly, allows the company to develop and maintain the position of a leader in the market.

Nevertheless, the company also has weaknesses, for example, lack of active advertising activities. Although the produced products are vital, i.e. does not need advertising, yet advertising activities could increase the demand for the products of «King-bread» LLC. Dependence from the outsourcing company on maintenance of the accounting system is also a drawback, for the solution of which it is necessary to invite highly qualified specialists to work, the availability of which will make it possible not to use the services of third-party organizations with respect to record keeping. With regard to accounting, weaknesses include the lack of the necessary level of automation of the accounting system, outdated accounting and costing technologies, and the lack of a budgeting system.

In connection with the development of the region and, in particular, Sevastopol, the opportunities for «King-bread» LLC include the growth of retail and wholesale trade turnover, as well as the growth in the turnover of public catering. It is impossible to exclude the possibility of receiving funds for the introduction of a new financial accounting system, the introduction of a budgeting system and a system for monitoring financial risks. The company also develops a medium-term development strategy (1-3 years).

The presence of threats to enterprises is also inevitable. «King-bread» LLC may face the following threats: an increase in duties on imported raw materials for production, a high cost of introducing a new accounting and financial planning system and deterioration in the financial position of the enterprise. To do this, it is necessary to carefully monitor the market trends and respond to its changes in time, possibly, thereby suffering minor losses. Threats to the company's activities can also be attributed to the lack of a working group for the introduction of new projects at the enterprise. Such a group would help to look more broadly at the development of the enterprise, discover new opportunities for it, and go deeper into the strategy of «King-bread» LLC, as well as ways to achieve it, because having a long-term business development strategy is a major advantage over competitors.

To develop a strategy aimed at entering the enterprise to a new level, it is necessary to analyze the external and internal environments of the enterprise. To study the external environment, a PEST analysis is used. PEST analysis (sometimes referred to as STEP) is a marketing tool designed to identify the political, economic, social and technological aspects of the external environment that affect the company's business [3].

PEST-analysis deals with the study of the macro environment, which includes a sufficiently large number of factors, therefore, only four key areas are considered from the total number of factors that have the most significant impact on the organization's performance (Figure 1):

- political factors (P): what are the opportunities and threats for business created by the dynamics of the political situation; what are the main trends that may affect the company's operations;

- the state of the economy (E): what are the most significant expected events in the economy and how the economic situation affects business prospects;

- socio-cultural characteristics (S): what are the characteristics of social, demographic, cultural properties that should be taken into account in the work;

- scientific and technical environment (T): to what extent business depends on innovations and changes; how dynamic the pace of scientific and technological progress in the industry is; what proportion of the function of R & D in the activities of the enterprise [4].

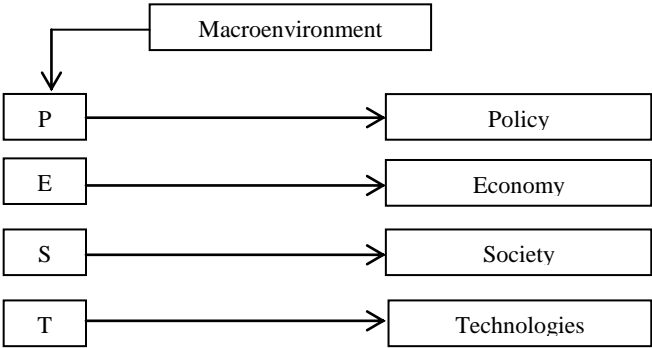


Figure 1. Components of the PEST analysis

To analyze the company in the external environment, PEST-analysis is used. This is a marketing tool that is designed to identify the political, economic, social and technological aspects of the external environment that affect the company's business. The analysis is presented in Table 2.

All factors were divided into 4 factors:

- political factors of the external environment;
- economic factors of the environment;
- social factors of the environment;
- technological factors of the environment.

We determine the degree of influence of factors:

- little effect;
- only a significant change in the factor affects sales and profits;
- influence is high.

The degree of influence of factors is presented in Table 2, and the probability of changing the factor is estimated in Table 3, where 1 is the minimum probability of change, and 5 is the maximum probability of change.

Expert assessment was given by the heads of financial services of the enterprise in the number of 5 people.

Table 2 – Degree of influence of factors

Description of the factor	Influence factor
Political factors	
1.1 Tax Policy	3
1.2 Antimonopoly and labor legislation	3
1.3 Legislation for the Protection of the Environment	3
1.4 The future and current legislation governing the rules of the industry	3
1.5 The likelihood of military action in the country	3
1.6 Restricting shipments from abroad	2
Economic factors	
2.1 Level of disposable income	3
2.2 Unemployment rate, size and terms of payment	3
2.3 Rates of major currencies	2
2.4 State subsidies in support of the industry	3
Socio-cultural factors	
3.1 Attitude to the imported goods	1
3.2 Requirement for product quality	3
3.3 Relation to natural and environmentally friendly products	2
3.4 Size and structure of the family	4
Technological factors	

Description of the factor	Influence factor
4.1 Level of innovation and technological development of the region	4
4.2 Legislation in the field of technological development of the industry	3

Table 3 - Assessment of the probability of changing the factor

Description of the factor	Effect of the factor	Expert review					Average rating
		1	2	3	4	5	
Political factors							
1.1	3	5	5	5	5	4	4,8
1.2	3	4	5	5	5	5	4,8
1.3	3	4	4	5	5	5	4,6
1.4	3	5	5	5	5	5	5
1.5	3	3	2	5	5	5	4
1.6	2	3	2	5	5	5	4
Economic factors							
2.1	3	3	4	5	5	5	4,4
2.2	3	4	5	3	5	5	4,4
2.3	2	3	3	2	2	3	2,6
2.4	3	4	5	5	5	5	4,8
Socio-cultural factors							
3.1	1	3	4	5	5	3	4
3.2	3	5	5	4	3	3	4
3.3	2	3	2	4	3	4	3,2
3.4	4	3	2	1	5	2	2,6
Technological factors							
4.1	4	5	5	4	4	5	4,6
4.2	3	5	4	4	5	4	4,4

The evaluation of the real significance of the factor is estimated by the formula 1 and is presented in Table 4.

$$\text{Real value} = \frac{\text{Average evaluation} \cdot \text{Influence of the factor}}{\text{The sum of factors}} \quad (1)$$

The sum of the factors is 45.

Table 4 - Evaluation of the real significance of the factor

Factors	Real value
1.1	0,32
1.2	0,32
1.3	0,3
1.4	0,33
1.5	0,27
1.6	0,18
2.1	0,29
2.2	0,29
2.3	0,12
2.4	0,32

3.1	0,09
3.2	0,27
3.3	0,14
3.4	0,23
4.1	0,41
4.2	0,29

The summary table of the PEST analysis is presented in Table 5.

Table 5 - PEST Analysis Summary Table

Factor	Factor
Political factors	
1.4	0,33
1.1	0,32
1.2	0,32
1.3	0,3
1.5	0,27
1.6	0,18
Economic factors	
2.4	0,32
2.1	0,29
2.2	0,29
2.3	0,12
Socio-cultural factors	
3.2	0,27
3.4	0,23
3.3	0,14
3.1	0,09
Technological factors	
4.1	0,41
4.2	0,29

Thus, developing recommendations for a significant increase in financial performance, it is necessary to pay special attention to improving production technology, as well as adapting the work of the enterprise when changing the external environment (economic and social factors).

«King-bread» LLC recommends a financial strategy – a concentrated growth in general accordance with the overall corporate and strategy of the firm.

The process of implementing the financial strategy of «King-bread» LLC should be based on the ability to provide competitive services, to form and reinvest the profits, to maximize the use of capital, etc. [5].

The main factor in the formation and implementation of the financial strategy is the consideration of risk factors. The enterprise of «King-bread» LLC needs to take into account the risks of the financial market, inflationary changes and insolvency.

For the management of «King-bread» LLC during the development of their financial strategy, it is recommended to set the tasks presented below:

- to identify the prospective financial relationships of the organization with third-party enterprises and other third parties;
- to provide «King-bread» LLC with financing of investment and operational activities;
- identify the ways and methods of successful implementation and use of financial opportunities by «King-bread» LLC;
- study for «King-bread» LLC economic and financial opportunities of potential competitors, engage in the development and implementation of measures to ensure financial sustainability.

Formation of the financial strategy of «King-bread» LLC should be part of the overall strategy for economic development. Based on this, it must be consistent with its tasks and areas. At the same time, the financial strategy will have a significant impact on the overall economic strategy of the organization, as fluctuations in the macroeconomic situation and trends in the financial market can become prerequisites for adjusting both the financial and overall development strategy of «King-bread» LLC.

It is also recommended that there is an alternative in the strategy, which is the most important distinctive feature of the whole system of strategic management of the enterprise and is connected with all elements of the strategic financial structure:

- financial goals;
- financial policy of «King-bread» LLC for specific categories of financial activity;
- sources of financial resources, style and mentality of financial management, etc.

«King-bread» LLC needs to keep a record of the degree of financial risk in the process of making strategic financial decisions. Almost all the main financial decisions that are taken in the process of creating a financial strategy lead to changes in the level of financial risk. First of all, it is connected with the choice of forms and directions of financial activity, the creation of financial resources, the introduction of a new organizational structure for managing financial activities. The financial risk is especially active during the period of fluctuations in the interest rate and inflation surges. In connection with the differences in the mentality of financial managers in relation to the level of permissible financial risk, in the process

of developing a financial strategy this parameter is established differentially.

Also, as a recommendation, one can take into account the reference to the professional resource of financial managers in the process of implementing the financial strategy. Even if specialists of other departments or freelancers are involved in the development of certain parameters of the financial strategy of «King-bread» LLC, its implementation should in any case be carried out by qualified specialists – financial managers. These managers are required to familiarize themselves with the key principles of strategic management, the management system of specific aspects of financial activity, and also own methods of financial controlling.

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**Аннотация.** В статье рассматривается процесс разработки определенной стратегии развития предприятия пищевой промышленности. С этой целью были проведены SWOT- и PEST-анализ организации пищевой промышленности ООО «Царь-хлеб». В результате представлены выводы анализа и рекомендации по построению стратегии для значительного роста показателей финансовой деятельности. Сделан вывод о необходимости особого внимания к улучшению технологии производства, а также адаптации работы предприятия при изменении внешней среды (экономические и социальные факторы). ООО «Царь-хлеб» рекомендуется финансовая стратегия – концентрированный рост в общем соответствии с общей корпоративной и стратегией фирмы.

**Ключевые слова:** стратегия, SWOT-анализ, PEST-анализ, пищевая промышленность, бизнес, конкуренция, прогнозирование.



**Summary.** The article deals with the process of developing a specific strategy for the development of a food industry enterprise. For this purpose, a SWOT and PEST analysis of the organization of the food industry of Tsar-Bread LLC was conducted. As a result, the analysis findings and recommendations for building a strategy for a significant increase in financial performance indicators are presented. The conclusion is made about the need for special attention to improving the production technology, as well as adapting the work of the enterprise when changing the external environment (economic and social factors). Tsar-Bread LLC recommends a financial strategy - a concentrated growth in general accordance with the overall corporate and strategy of the firm.

**Keywords:** strategy, SWOT analysis, PEST analysis, food industry, business, competition, forecasting.

UDC 502.3

### THE PROBLEM OF “BRAIN DRAIN” IN RUSSIA

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"Brain drain" or emigration of the scientific intelligentsia from Russia as a consequence of the increasingly lower demand for science in our country is an agent problem of Russia nowadays. Radical reforms in Russia have led to the fact that the strategy for the development of science has been replaced by a strategy to support it at the lowest possible level.

The purpose of our article is to describe the reasons of human capital outflow from Russia. Firstly, we define the concept of “Brain Drain”; secondly, we analyze the damage brain drain brings to the country.

According to Cambridge English Dictionary: “Brain Drain – is the situation in which large numbers of educated and very skilled people leave their own country to live and work in another one, where pay and conditions are better” [6, www].

The problem of brain drain, the scientists studied Abramova M.A., Aleksandrova L.C., Kamaev V.D., Sevastyanov A. N. and others.

If a certain percent of the population is prepared to leave the country at the earliest opportunity, it is said, that a country does have a drain of people in general and “brains” in particular. Brain – drain is mostly common for the younger generation, but people of retirement age might also have a desire to leave their motherland [3].

In particular, 33.6% of the flow of Russian scientists traveling abroad are physics, 22,8% are biologists, 12,7% are professionals in the technical sciences, 9.3 percent – mathematicians, 6,1% – for chemists. Among Russian scientists going to work abroad, 18% of scientists had doctor's degree and 55.8% are candidate of sciences [5].

Population shift – any territorial movement which is made between different settlements of one or several administrative and territorial units irrespective of duration, regularity and target orientation.

Intercountry population shift and a manpower arises with considerable contrast in levels of economic and social development and rates of a natural demographic increase of the countries accepting and giving labor. The geographical centers of immigration are the most developed countries, such as the USA, Canada, Australia, the majority of the Western European countries and also the countries with high oil revenues and rapid economic growth. International experience demonstrates that labor migration provides undoubted advantages both to the countries accepting labor and delivering her. But it is capable to create also acute social and economic issues.

The special problem is presented by so-called "Brain drain" - emigration of highly qualified specialists from developing countries to the developed countries including with transitional economies. Traditionally understand withdrawal from the country of the creative intellectuals, creators and the main carriers of cultural, cultural, scientific and other intellectual values, i.e. elite of society which substantially defines his cultural, scientific and technical and social and economic progress as "Brain drain". The term "brain drain" has appeared at a boundary 40 — the 50th years in the developed countries of Western Europe for designation of the new phenomenon caused by consequences of World War II. The speech then went about mass departure of talented graduates of the universities of Europe, the young people aimed at scientific activity and continuation of education across the ocean, generally to scientific centers of the USA. First of all this process has affected Great Britain, Germany, Italy, to a certain extent France. As a result of "brain drain" the whole scientific directions have suffered. In other words, "brain drain" is loss of the intellectual capital - one of the most significant resources in modern society [4].

This term has gained distribution in our country rather recently. With transition to the new market relations, Russia faces a number of serious

problems. Among them there is one problem, without having resolved which, there will be impossible a further economic development of our country is a problem of "brain drain". And one of the main tasks of the state consists in resolving this difficult task by development of the system of programs and carrying out the correct policy on regulation of labor market of the qualified labor and to permission of questions related.

Let consider the main reasons for "Brain drain" from Russia.

Addressing consideration of process of intellectual emigration in Russia, we will note that the main reason and the leading factor of this process - the current crisis of domestic science

And also outflow of scientists abroad happens on some other not less important reasons:

- The low and more and more going down level of prestige of science;
- Illusoriness of further prospect in scientific career and activity;
- Not demand of professional knowledge and creative abilities of scientists;
- Low level of compensation [1].

The instability of a political situation, threat of the social conflicts, concern for the fate of the children, the general deterioration in an economic situation, unemployment threat, low level of social security scientific-all these factors influence the decision of the Russian scientists to get over abroad.

However there are also factors which are slowing down "brain drain". The main reasons to stay at home were: desire to work only in the country, an opportunity to realize itself, the scientific plans here, patriotic sentiments.

Maintaining intellectual potential of Russia and further development of domestic science – an important and relevant task on which solution not only the state of the economy and the standard of living of Russians, but also independence of the country in general in many respects depends. Despite the attempts made just in recent months to somehow raise wages of scientists, before, to balance them with earnings of foreign colleagues, still very far. The salary in science below a living wage, and in comparison with the developed countries of the West compensation of the Russian scientists is 40 - 50 times lower.

Actions for control of "Brain drain":

– First, to order the dragged-on preparation of laws in the field of regulation of the rights for intellectual property long ago. In this sphere already several years the situation practically doesn't move a little.

– Secondly, to continue and expand cooperation, including within programs of the international organizations and foreign funds;

– Thirdly, in the attitude towards scientific diaspora abroad not to be engaged in enticement of scientists back at all, and to suggest them to participate in development of current scientific problems for the benefit of the country. And that there were no conflict situations, issues of distribution of the rights for intellectual property have to be resolved first of all.

– Fourthly, that it was possible to set interesting scientific tasks, it is necessary to direct considerably big, than today, funds for updating and development of laboratory and instrument base of researches. Besides, it is important to pay attention to faces which are ready to help in cash domestic science. Today in Russia such rules at which it isn't favorable to anybody to support science continue to work [2].

#### Conclusion

It is difficult to count consequences of "brain drain" in rubles. However it is obvious that this process leads to weakening of scientific capacity of the country, disintegration of schools of sciences, folding of a number of basic researches in Russia. Due to the lack of housing inflow of young scientists doesn't make up for losses due to migration. The cities of science owing to small number of the population are very sensitive to external social and political influences. From the point of view of economic risks "brain drain" represents a serious problem for Russia. Receiving good base, graduates of the universities and postgraduate studies go to the west to continue the education. Often they receive offers on work, remain, and the obvious economic damage to our country as the basis for further professional growth is abroad provided exactly here, in Russia consists in it.

It would be incorrect to say that the western science takes away from all of us experts. Economic downturn in the USA was resulted by toughening of migration policy in the sphere of science and high technologies. It leads to reduction of inflow of foreign, including Russian experts to the USA. In it there are pluses.

But it should be noted that in 10-15 years the positive moments can become negative. For this term national security can be weakened so that pluses won't be able to compensate minuses any more. It is very difficult to make up for the missed time and benefit. By the way, the similar situation can take, in principle, place and at the personal level as not always adaptation of emigrants in the country of entrance happens successful. Effective protection of safety of scientists, societies and the states can be provided only in the presence of the flexible and effective system of regulation of intellectual migration.

It is important to change the attitude towards scientists. It is important to make so that the word "scientific intellectuals" has stopped being associated with something low, illusive, humiliating. In fact, the number of

the scientists leaving the native land isn't so high but the whole scientific direction can disappear.

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**Аннотация.** В статье исследовано влияние миграционных процессов на социально-экономическую жизнь России как одно из самых неблагоприятных явлений, которое привело к "утечке умов". Основная цель данной статьи – исследование проблемы "утечки умов". В данной работе освещаются сущность и основные причины "утечки умов", а также действия и процессы регулирования данной проблемы на основе анализа различной экономической литературы, охватывающей данную проблему.

**Ключевые слова:** "утечка умов", компенсация, иллюзорность, профессиональные знания, творческие способности.

**Summary:** Influence of migration processes on social and economic life of Russia ambiguous along with positive consequences is also negative among which, perhaps, one of the most adverse phenomena - Brain drain. The main idea of this article is devoted to a problem of "brain drain". In this work the essence and the main reasons for "brain drain" are covered and

also actions and processes of regulation of this problem on the basis of the analysis of various economic literature covering this problem are described.

**Keywords:** "brain drain", compensation, illusoriness, professional knowledge, creative abilities.

UDC 3348.2

## **THE PROBLEM OF LACK OF INFORMATION AS A CHALLENGE TO THE FINANCIER IN THE CONDITIONS OF DIGITALIZATION OF THE ECONOMY**

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The problem of lack of information occurs and calls into question the effectiveness of the measures. Thus, within the framework of the digitalization of the Russian economy, there should be more information provided by official sources. So, the publicly available information will help create not only reasonable and objective opinion from experts financiers, but also the appearance of a "fresh" (including independent) view of the existing problems.

The relevance of the research is supported by the challenges that arise in the process of digitalization of the economy [1]. So, in July 2017 the program of the digital economy development in the Russian Federation was approved. The appearance of new technologies is the emergence of new challenges, tasks and competencies for all professions, including financiers [2].

So, against the background of the growing general information nowadays, the complete or partial absence of information about economic projects is discussed as new challenges. There is a new competence like the ability to work with limited information and the use of all available information resources for economic analysis. It seems appropriate to consider this issue and give the example of the pilot project of production labeling.

In 2014 Council of the Eurasian Economic Commission took the

decision to establish a labeling system to monitor the movement of goods and to ensure the legality of the import and production of goods on the territories of the states - members of the Eurasian Economic Union [3, 13].

Wherein, the process of implementation of the pilot labeling can be divided into 3 stages. The first stage includes the creation of the legal and regulatory framework governing the project in the period from 2014 to 2015. Legal and regulatory framework is in the public domain and anyone can read it. The second stage includes the development of software and equipment at the national level during the period from 2015 to 2016. The third stage gives the beginning of the project and alternate labeling of separate goods.

In early 2018, the labeling of tobacco products in the Russian Federation began. [4] Now, the list of labelled goods is limited, but soon it will be expanded (mandatory medicine labeling will be introduced in mid-2018, marking shoe will begin by the end of 2018) [5, 6, 12]. The project lasts about four years, but there is not enough information about it in order to draw any conclusions.

Thus, table 1 shows assessment of information transparency in the process of implementation of the project of marking of goods in the context of the above-mentioned stages.

Table 1

Assessment of information transparency in the process of  
implementing the project of marking goods

Name	step 1	step 2	step 3
What kind of information should be given?	General information (publication of normative legal acts, evaluation of international experience and the results of a survey of business and civil society)	Information on public procurement, the contractors involved in the implementation of projects.	Information on the amount of sales of products that have passed the labeling process in absolute and relative terms, as well as details, statistics for each type of product involved in this project should be given.

What kind of information is given /not given?	Published regulations adopted by the Eurasian Economic Council; It is not given in the public domain	The information is given, but not enough. No detailed costs of organizations implementing the project. (Financial statements, the cost of each development that is equipment and chips)	Only a summary is presented. There is no information in absolute terms and details Items.
What is the missing information for?	To prepare for the project implementation in advance to plan the cost of the project. To assess the risks associated with the introduction of the new project not only to businesses but also for the state.	Provision of state financial control, the fight against corruption. Identification of inefficient spendings for the state.	The competent authorities will be able to timely intervene to prevent illegal actions on the part of organizations and public authorities. Experts financiers will be able in a timely manner to form an objective assessment of the effectiveness and feasibility of nested budget, and to identify shortcomings and disadvantages of the project implemented.

Source: authoring



The project is really promising but there are several circumstances that hinder the effectiveness of evaluation. The lack of data does not allow to assess the impact of this instrument on the sales of fur products, as well as the impact on other industries in which the marking has become mandatory [8]. In fact, the Federal State Statistics Service, Federal Tax Service, Ministry of Economic Development do not provide data in the public domain. So, even attempts to indirectly assess fail, because «Rosstat» provides data on changes in relative terms, for several years, but not a layout of specific types of fur, that is natural or artificial fur; fur trade in the national currency is not given. Market researches (which do not guarantee that the information provided is accurate), as a rule, are not available to the financier because of their high price [10].

Data on exports and imports of fur products are given only in the portal <http://ru-stat.com>.

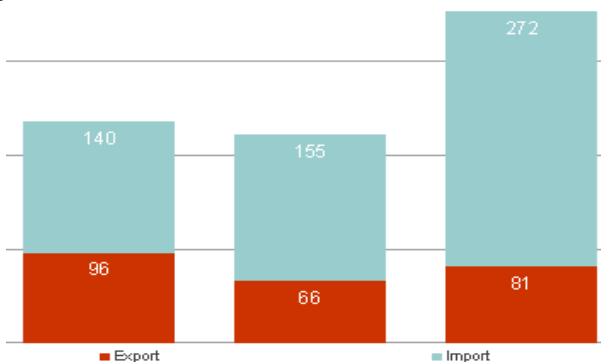


Figure 1. Dynamics of furs trade in 2015-2017

Source: Compiled by the author based on the data [15]

The information is not formal, and hence does not belong to the category of reliable information. Unfortunately, this is the only source that provides a layout of the specific types of goods, in absolute terms.

The head of the Federal Tax Service at a conference in 2016 stated that the number of objects in taxation increased by 16 times [14]. Unfortunately, there is no confirmation in official statistical reports. The effectiveness of this experiment depends on many factors, so the provision of data on the projects implemented will allow at the early stages to identify shortcomings and correct them in a timely manner [9, 12, 13]. Moreover, its implementation is of particular importance in the context of modernization of financial control [7].

It should also be noted that labeling is carried out only in two member states of the Eurasian Economic Union. These countries are the Russian

Federation and Belarus. There is also a lack of information about the project in Belarus in size, which is essential for an objective analysis.

According to the results of the study it is necessary to draw several conclusions:

1. Digitalization of the economy should contribute to greater openness and transparency both for the country and for citizens, but in practice this does not always happen. Lack of information is a real problem.

2. New challenges create new tasks and competence of the representatives of any professions, including financiers.

3. Marking is one of the tools that fits into the concept of the digital economy, but how well it is an open question, the answer to which is possible only in solving the problem of lack of information.

4. At the same time, technology is developing at great speed and it is necessary to use them in time, including in improving the transparency and reliability of the information, that ultimately will promote growth.

5. The Federal Tax Service is a provider of information on goods labeled. The Federal Tax Service has information about this project, which means that it is the federal tax service that should provide open access to all the necessary information on the matter.

6. The federal state statistics service shall provide statistics on the amount of fur products sale, not only in relative but also in absolute terms. A layout not only in economic activities, but also in goods to assess the impact of innovation is required.

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**Аннотация.** В эпоху интернета стало гораздо проще найти необходимую информацию и это, безусловно, положительный момент. Однако её слишком много, что усложняет процесс поиска. Слишком много источников публикуют информацию, но далеко не всегда представленная информация является достоверной. Отсутствие информации является одной из главных проблем для финансистов. Без информации нельзя дать объективную оценку экономическим процессам, которые непосредственно влияют на жизнь каждого

гражданина.

**Ключевые слова:** информация, доходы, бюджетная система, бюджет, маркировка, цифровая экономика.

**Summary.** In the era of the Internet it has become much easier to find the information you need, and it is certainly a positive thing. However, there is too much information, that complicates the search process. Too many sources publish information, but not always the information provided is accurate. The article is devoted to marking as a mechanism that can increase the revenues of budgets of the budget system of the Russian Federation and combat corruption. The author pays special attention to the lack of information is one of the main problems for financiers. In the absence of information it is impossible to make an objective assessment of the economic processes that directly affect the life of every citizen.

**Keys words:** Information, income, budgetary system, budget, labeling, digital economy.

UDC 339.1

## **USE OF SOCIAL MEDIA MARKETING INSTRUMENTS IN THE EVENT AGENCY MENZELLI GROUP**

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### **Introduction**

My research is based on the use of SMM instruments in business, in particular, in the Menzelli Group event-agency. The event-agency is a profitable type of business which doesn't require initial big investments. One of main goals of my research is not only to help the company to promote the implementation of SMM instruments in it, but at the same time it is fairly important to make all this executed work and experience useful to others, and also to help others to avoid mistakes during the opening of business and implementation of information technologies.

Today many entrepreneurs perceive the IT sphere as a compulsory measure, which formally shall be present in business, and such opinion extends in many enterprises. However, in our time competent specialists realize all the importance of using information technologies in business, and

consider them as updated means of increase its efficiency. Business considers information technologies as a source of their performance and improvement of competitiveness. The Efficiency of all business processes increases due the automation provided with IT services. (A survey conducted by Forrester Research, which covered above three thousand heads of big companies, confirmed that [3]) the IT is one of basic elements of a business model promoting cost reduction of business and acceleration of business innovations [3, p. 2-20].

Menzelli Group is the Georgian event-agency, which organizes and decorates different private events (festivals, concerts, conferences, ceremonies, formal parties) on turn-key terms and has niche marketing strategy described in the main part of work.

Today the Internet is the information environment, which constantly develops. The main trend in the functioning of the Network now is its socialization. The amount of audience of social networks constantly grows and for a long time exceeded above one billion users. Nick Newman, the research associate of Reuters Institute in the article notes the importance of quality of content for promotion on social networks. It researched the Telegraph newspaper and showed that the edition has big and various material, but not everything from published is caught in social networks. Only the most important thing can be interesting to the audience of a social network, lead to high rates of an involvement and cause a feedback, takes place on these platforms. His work includes the research of the New York Times. one of The main community promotion tools - repost of the material. Thus, the audience, which will adjoin to edition posts significantly, increases at the expense of friends of users. At the same time, Nick Newman notes that the The New York Times pages on social networks are an active discussion platform. The newspaper sees promotion prospects in initiation of discussions and encouragement of creative potential of active audience [5, p. 5-52].

Having projected the research conducted by Newman [5, p. 5-52] on our business, and having united the practical knowledge gained by means of an own experience it is possible to draw several conclusions. The practical research of Nick Newman concerning the relevance of the Facebook social network, the biggest social network in the world, is confirmed by our experience. Publications of the page of the Menzelli Group event-agency in Facebook, unlike the similar page on the leading Russian social network "VKontakte", extend much easier and cover the bigger number of users by means of reposts, the marks I like, and also marks of users in the publication. Proceeding from it, one may say, that at the expense of social networks, in particular, Facebook, the companies not only can increase

attendance of own websites but also use these platforms for forming of communities of loyal audience and promotion of the brand. It means that the modern companies start to see the tool in social networks, which will help with promotion of their activities and preserving of the importance of the brand on social networks. As for the Website of the Menzelli Group event-agency, it is in active development now. Creation of the website is necessary for our company, as it will advance services of the agency to provide information and reports on its activities and to attract new partners, etc.

Social networks are an important advertising platform and means of interaction between business and IT, which has several basic advantageous positions: there is the possibility of quickly finding the target audience; in connection with the growth in the number of users of social networks, the target audience has a tendency to grow; pages in social networks on an equal basis with official sites are indexed in all search engines; maximal simplified access to pages in social networks, since people can access the information they need without leaving the page on the social network; the possibility of implementing an effective official fee-based advertising, covering a large number of users, while you can specify your target audience and its interests.

**Social media marketing (SMM)** is the use of social media platforms and websites to promote a product or service[2].

In the promotion of our agency the following social networks and applications were used: Facebook, VKontakte, Instagram, YouTube, ShowApp. Advantages and disadvantages of these services for the promotion of our agency were presented using Tables 1, 2, 3, 4, 5.

In order to improve the effectiveness of promotion in social networks, our team has made several important steps. Let me tell this in order:

1) Facebook (*Table 1*). Creation of thematic personal pages in order to attract a large number of the necessary target audience. Since our company has gone according to the scheme of the niche marketing strategy, that is, the events are conducted mainly with the Georgian theme. Accordingly, in the majority, the Georgian audience is welcome. Facebook allows you to create personal pages and add an unlimited number of friends in one day (the total limit is 5000). For example, we created a similar page that could attract such an audience - text, photo and video materials on Georgian subjects were published in it. Now let's see what this page gives with a lot of friends, or rather, the target audience. As in the social network "VKontakte", on Facebook, people can invite groups of friends to public groups, regardless of whether they are community administrators or not. In Face-book, you can send this invitation only once.

Table 1. Advantages and disadvantages of using Facebook

<b>Social network</b>	<b>Advantages</b>	<b>Disadvantages</b>
Facebook	<p>1) Publications of the page of the event-agency "Menzelli Group" in Facebook, unlike a similar page in the leading Russian social network "VKontakte", are much easier to spread and cover a larger number of users with the help of reposts, I like it", as well as from the labels of users on the publication</p> <p>2) Potential investors and businessmen noticed our page in this particular social network</p> <p>3) Allows you to make direct translations that are actively viewed</p> <p>4) Ability to create public events</p>	<p>1) There are users who refer to the fact that they do not know how to use Facebook because it is relatively more complicated than Instagram and VKontakte.</p> <p>2) Facebook, with all its merits, does not replace the official site of the company, which, in turn, adds to it the status and enhances the image.</p>

*Source:* Made by author

2) VKontakte (Table 2). We used the VKontakte group not as the main platform for posts, since many of them do not cover the main part of the audience.

Table 2. Advantages and disadvantages of using VKontakte

<b>Social network</b>	<b>Advantages</b>	<b>Disadvantages</b>
VKontakte	<p>1) Ability to create public events</p> <p>2) The Russian social network, where, basically, there is a basic communication between people</p> <p>3) Unlike many social networks, here you can listen to music. In our case, this adds an audience of activity and users devote this social network more time.</p>	<p>According to statistics, this social network is pre-eminently seated by young people, the older generation prefers Facebook</p>

*Source:* Made by author

The group allows you to download photos from the event in normal quality, as well as view basic video materials. It's very convenient that you can put videos from YouTube on the wall of the group without losing quality. And when users go to the group, and they see this video, it automatically opens, therefore, views are typed. Accordingly, it helps YouTube videos become more "viral".

3) Instagram (*Table 3*). Most companies that organize their promotion in this social network wind up subscribers. There are programs that allow them to wind up for free.

Table 3. Advantages and disadvantages of using Instagram

Social network	Advantages	Disadvantages
Instagram	<p>1) Laconism of the information provided;</p> <p>2) The opportunity to interest people with a bright photo / picture attached to the post</p> <p>3) Ability to create pages as an event-event and subscribe to users, thereby advertising the event</p> <p>4) Possibility of carrying out an official paid advertising campaign both through a new service "Stories", and through traditional advertising posts.</p> <p>5) A big role in the promotion of the post is played by hashtags, which are usually reinforced by the postures on the page</p>	<p>1. Limitation in the amount of information for the post. Sometimes a lot of important information does not fit, accordingly, the audience does not see it.</p> <p>2. The common problem of all social networks - not all adult categories are in the social network Instagram.</p> <p>3. Some the most popular hashtags were abolished, so their effectiveness was reduced</p>

*Source:* Made by author

The problem is that the modern audience is enlightened in these actions. When users visit the company's page in Instagram, they look at the number of likes, video views, comments, and also on the subscribers themselves. Often there is a psychological ottal-nicking of a person from a page with a large subscription of subscribers. For example, there are 10 thousand subscribers on the page, and there are only 50 video views on it.



Of course, people start to guess about not quite honest methods of promotion of business.

4) YouTube (*Table 4*). As mentioned earlier, it is very convenient to keep on the YouTube channel a video presentation of the business, which is his business card. But this video can be used in the future not only for potential investors and partners, but also for crowdfunding. After all, in order to take part in it, it is important to make a very high-quality video, with which users will want to participate in the project.

Table 4. Advantages and disadvantages of using YouTube

<b>Social network</b>	<b>Advantages</b>	<b>Disadvantages</b>
YouTube	<p>1) "Viral" video. This social network allows you to quickly distribute the advertisement of the project.</p> <p>2) Potential partners, for example, in correspondence by mail, need a presentation of the company. A banal presentation in Power Point is an outdated method of presenting information. It is much easier to open a link on an international public website and see everything with a single click.</p>	<p>1. YouTube - specialized video hosting. All posts that are posted on this site must be backed up with video materials.</p> <p>2. This site does not provide communication, accordingly, the activity of users comes only from a search query in the browser or on the same site</p>

*Source:* Made by author

5) ShowApp (*Table 5*). This application has groups in various social networks, and also actively collaborates with other thematic groups. Employees of the application actively respond to all questions and absolutely help us to talk about the event with a lot of resources.

Table 5. Advantages and disadvantages of using ShowApp

<b>Social network</b>	<b>Advantages</b>	<b>Disadvantages</b>
ShowApp	It allows not only to follow the events in the city, but also to create your own by inviting your friends there.	The application is new, it just begins to collapse. The audience is not so high yet.

*Source:* Made by author

In our opinion, there are other social networks that can be useful for promotion, but so far we have not been used. They can open new opportunities for the promotion of the event-agency Menzelli Group. These are social networks like Twitter and Periscope.

We will open up potential opportunities for promotion of the event-agency:

1) Periscope allows you to make live broadcasts that absolutely unknown people can find by location. If in other social networks, broadcast notifications only come to friends or appear in recommendations (Instagram). Pre-property is great - many users who do not know about the agency's activities can learn about it by broadcasting from an event.

2) Twitter - a very convenient network for text posts. It can be done as a news social network for the event-agency.

Undoubtedly, the most visited social networks in our country are Instagram (more than 600 million users) [7], VKontakte (more than 380 million users) [8], Facebook (almost 2 billion people worldwide) [6]. Despite all the above advantages of promoting business in social networks, the question arises: "Do you need a site for an event-agency, if it is so productive to promote social networks?". For clarity in the form of Google, a social survey was created, shown in Picture 1, which was attended by both novice business men and professional analysts. Almost unanimously the respondents supported the view that the official website, in any case, is not bypassed. But only for prestige and recognizability? Of course, no. There are several key positions that show the need to create a website for conducting and promoting a business:

1) the site provides more opportunities for the business owner, starting with the choice of his design;

2) the potential audience is much wider, because it is unlimited, registration on the site is not necessary;

3) some Internet users are not active in social networks or do not know how to handle them, accordingly, it is much easier for them to work with the site;

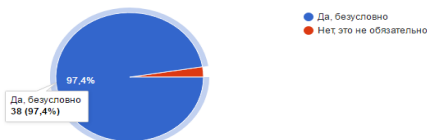
4) the site provides more opportunities for monitoring and additional earnings (allocation of any resources, etc.);

5) the site is a corporate electronic business card of the brand, which in the eyes of the client looks much more solid than the page in the social network.

### Необходимость официального сайта и приложения для ведения бизнеса

Если бизнес уже имеет свои конкурентные преимущества, неплохо раскручен, нужен ли официальный сайт?

39 ответов



Picture 1. A sociological survey in Google Forms

Source: Made by author

### Specific features of the event business promotion on social media

So, specific features of the event business promotion on social networks:

1) Activities always involve photo and video reports. After them, users are especially active in social networks (for example, they are waiting for a photo report in VKontakte albums, a video report from the event on YouTube);

2) Live broadcasts from social networks, especially Facebook, Instagram and Periscope make it possible to convey the atmosphere of the event very brightly and in the future to attract even more guests;

3) In our own experience, promotion in social networks is fully enough to at least recoup all expenses from the event. If the advertising campaign is done correctly and in full, then other marketing tools may not be absolutely necessary. Usually we start an advertising campaign in social networks 3 weeks before the event.

4) It is very convenient to use social networks for direct (or through intermediaries) connections with popular users for barter advertising (in our case, we give tickets for the upcoming event, and in return the user puts a photo of the ticket or something else, marking our page). It is also very convenient to do contests, especially through Instagram.

In conclusion, it would be desirable to note that all studied references were useful, and, despite distinctions in some approaches, results of scientific research supplement each other and can be used further in case of more global studying of connection of SMM instruments with business, in particular, the event-industry. For development of the Menzelli Group company it is necessary not only to advance it on popular social networks, but also to create the final official website as we need to provide its preferential competitive line items in the market. Practical benefits of work were also reached because the theses provided in it can serve as quite good

recommendations for those who are engaged in business or are going to create it.

**Summary.** The beginning of the article reveals the importance of research. In the second part, the definition of SMM is given, the promotion tools that we have applied, their advantages and disadvantages are described in detail. In the third part of our study, we investigate tools that were not used for promotion, but can be useful. In the end, the specificity of promotion of event-agency in social networks is determined and necessary conclusions are drawn. The study was useful, because for today on the Internet there is a lot of information about SMM tools, but there is no specific information about the progress. This article presents a real-world study using the example of a real company, which can be very useful.

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**Аннотация.** В данной статье автор исследует литературные источники об использовании инструментов продвижения в социальных сетях на примере event-агентства "Menzelli Group" - грузинского агентства по организации мероприятий, а также

украшению различных частных мероприятий (фестивалей, концертов, конференций, церемоний, корпоративных мероприятий. Компания заняла нишевую маркетинговую стратегию на рынке, более подробно это описано в основной части работы. Данное исследование является актуальным, поскольку на сегодняшний момент в сети Интернет имеется много информации об инструментах SMM. В статье приведена не только актуальность исследования, но и даётся определение SMM, детально исследуются инструменты продвижения, их преимущества и недостатки. В заключении определяется специфика продвижения в социальных сетях в event-агентстве, а также сделаны необходимые выводы.

**Ключевые слова:** event-агентство, SMM, информационные технологии, социализация.

**Summary.** In this article, the author considers the literature about using SMM instruments in the Menzelli Group, an event-agency, as an example. This is a Georgian event-agency, which organizes and decorates different private events (festivals, concerts, conferences, ceremonies, formal parties) on turn-key terms and has niche marketing strategy described in the main part of work. The study is useful, because for today on the Internet there is a lot of information about SMM tools, but there is no specific information about the progress. This article reveals the importance of research; it gives the definition of SMM, details the promotion tools that have been applied by us, their advantages and disadvantages. At the end, the specificity of the promotion of event-agency in social networks is determined and the necessary conclusions are drawn.

**Keywords:** event-agency, SMM, information technologies, socialization

UDC 334.722.1

## **THE PROBLEM OF DEVELOPMENT OF SMALL AND MEDIUM-SIZED BUSINESS IN THE RUSSIAN FEDERATION**

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One of the problems that the economy of Russian Federation faces is the development of small and medium-sized businesses. Small business in Russia is developing gradually, slowly and not easy and it is an important part of the national economy. However, in Russia small businesses are closing much more than opening new ones. The share of small and medium business is about 20% in the volume of GDP in our country, while abroad, only for small businesses, this figure reaches 50%.

The growth rate of the number of registered sole proprietors (SP) in our country remains low – each year their number increases by 4%, while the number of SPs that have ceased their activity increases by 11%. According to the Federal Tax Service in April 2015, 3.5 million sole proprietors were registered in the Unified State Register of Individual Entrepreneurs and 7.7 million people ceased their activities.

The main reasons for this negative trend are administrative and economic barriers. Firstly, there are technical problems associated with the registration of an enterprise, receiving licenses, opening bank accounts, collecting inquiries and other administrative barriers.

Secondly, the normal development of small and medium-sized businesses is constrained by a weak material and technical base: lack of or inadmissibility of premises, equipment, modern technologies, qualified personnel, legal support, reliable information, state participation in small business support programs.

Thirdly, serious influence on small businesses are having financial problems, associated with the legalization of income and capital, tax evasion, the conduct of double-entry bookkeeping.

Fourth, this is a problem of obtaining loans for business development and servicing of capital turnover. The main role in the financial support of entrepreneurship should be played by the tax policy. The taxation system should stimulate the increase of the technical level of enterprises, the saturation of the consumer market, the development of industries that use secondary resources and thus contribute to the recovery of the environment, that is very important in the modern world [3].

Fifthly, this is a rather complex and voluminous legislation, which, moreover, is very often changed. At the same time, there is no full information on the changes that are taking place, and it is quite expensive to use the services of professional lawyers in small business. Consequently, proprietors often make mistakes and violate legislation, resulting in high fines [2].

The formation, functioning and development of small and medium-sized businesses, its structure and dynamics depend critically on a number of political and socio-economic conditions of a particular country. In order

for a small business to fulfill all the tasks for which it is intended, in order for it to fully realize its potential and use all its advantages, it needs the support of the state.

The experience of developed countries shows that in each of them a state policy of development and support of small business has been elaborated. To realize this policy, special state public organizations have been established. In the USA, for example, operates the Administration for Small Business, which provides comprehensive support to small businesses [4].

A certain system of supporting small businesses is also being developed in the Russian Federation. A great impetus to the creation and development of small enterprises was the Law of the RSFSR of 1990. "On Enterprises and Entrepreneurial Activities" and the Resolution of the Council of Ministers of the RSFSR No. 406 "On measures to support and develop small enterprises in the RSFSR". This law and the government resolution opened wide scope for all those who are inclined to business activity, created conditions for the implementation of economic initiative and pushfulness on the basis of the principle of equality of all forms of ownership, free directive of property and choice of field of activity [1].

To date, the state is keen on the development of small and medium-sized businesses. In the Address of the President of Russia, the priorities of the long-term development of the economy were clearly defined, which are as follows [6]:

- providing tax breaks for beginners;
- the possibility of opening your business in 2-3 days;
- amnesty for the return of capital from offshore zones;
- lack of inspections of supervisory authorities within a 3-year period from the moment of opening of the business;
- expanding the access of small businesses to purchases of state companies, natural monopoly entities, state corporations, etc.;
- the ability to conduct commercial and non-commercial activities within a single legal entity;
- preservation of property from creditors and raiders;
- lack of licensing for many types of activities, including for conducting banking operations, etc.

The Ministry of Economic Development of Russia is implementing a special program to provide subsidies from the federal budget. Within the framework of this program, activities related to the reformatting of the network of organizations that form the support infrastructure, the introduction of a service model for its provision. This program provides for a set of measures, including more than 20 activities aimed at meeting the

needs of entrepreneurs in financial, property and information resources. The Ministry of Economic Development of Russia creates a network of infrastructure for supporting small and medium-sized businesses, which includes lending assistance funds (guarantee funds), business support centers, multifunctional business centers and others. Also, the Ministry of Economic Development of Russia is implementing a set of measures for financial support of small and medium-sized businesses.

To ensure the access of small and medium-sized enterprises to credit and other financial resources, the development of a system of providing guarantees and independent guarantees, the Ministry of Economic Development's support program provides for the creation and development of credit promotion funds, the activities of which are regulated by the Ministry's order. In addition, to enhance the potential of guarantee organizations, the main provisions of the Development Strategy of the National Guarantee System for Support of Small and Medium-sized Entrepreneurship have been approved for the period until 2020.

In 2018 state support of small business consists in the adoption of programs and the implementation of measures by local authorities in accordance with federal state programs. Small business support programs in 2018 are expressed in the form of grants, grants, free education (or training at a minimum cost), internships (workshops), providing free or reduced legal, accounting services, reimbursement of expenses (or discounts) for participation in promotional activities, as well as in fairs and exhibitions and so on [5].

To date, in some regions of the Russian Federation, small business development programs have already been adopted, which are designed for a long term. These programs regulate the conditions for functional as well as material support for small businesses.

In the context of these programs, activities are identified that will contribute to an innovative approach to the development and management of small businesses. During the implementation of small business support programs, there is a redistribution of budget funds between regions to implement local programs. In particular, support for small and medium-sized businesses is aimed at the development of small business start-ups and entrepreneurs, who are mainly engaged in agriculture, industry and production.

Thus, small business support in 2018 is aimed not only at developing the level of small business, but also at creating qualitative conditions for the development of the Russian economy as a whole. It is planned to increase the inflow of entrepreneurs into small businesses [5].

It should be noted that the undoubted prospects of the small and



medium-sized business sector in the modern economy and, therefore, the great interest in it should not be viewed only as a regular company in the system of anti-crisis measures, but also as a long-term direction of structural policy that naturally ensures the unification of reproductive and market processes in the Russian economy, the implementation of a modern strategy of economic growth during a long-term transition. After all, it is small enterprises, especially in the case of satisfactory development of a new state policy in the field of small business, can become the basis of market structures in many industries, ensure the flow of investments into the spheres of the most effective application of resources and thereby connect the processes of structural policy and the formation of the all-Russian market [1].

Thus, small, as well as medium-sized enterprises - this is the main element of the market system of management. It determines the business activity of the national economy, it is here that the creation of products occurs, the direct connection of the worker with capital. Here the most qualified personnel are concentrated, and also questions of economical use of resources and application of high-performance equipment and technology are solved. At the same time, small businesses, creating jobs, provide employment for the population, through the payment of taxes participate in the implementation of social programs. That is why it is necessary to support small business, to stimulate its activity.

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**Аннотация.** Главная идея доклада – характеристика малого и среднего бизнеса как института в современной экономике страны, что является стратегическим направлением развития экономики. Благодаря их функционированию происходит формирование благоприятной экономической среды, увеличивается конкуренция среди товаропроизводителей, появляются новые рабочие места, происходит развитие рыночных отношений в целом. Однако развитие малого и среднего бизнеса неизбежно сопровождается рядом проблем. Отмечено, что малый и средний бизнес обеспечивает высокую динамику экономического роста, помогает решать проблемы реструктуризации экономики, не требует крупных вложений, обеспечивает занятость существенной доли экономически активного населения и высокую производительность труда; способствует формированию конкурентной среды и установлению рыночного равновесия.

В заключении говорится о том, что стратегия развития малого и среднего бизнеса на сегодняшний день является приоритетным направлением развития экономики; особую роль в поддержке такого бизнеса играет государство. Автор приходит к выводу, что развитие малого и среднего бизнеса позволит решить проблемы безработицы, повысить производительность труда, насытить рынок инновационными нововведениями, решить вопросы, связанные с инфляционной неустойчивостью российской экономики.

**Ключевые слова:** малый бизнес, средний бизнес, развитие, экономика, предприятие, рынок.

**Summary.** The main idea of the report is the importance of small and medium business as an institution in the modern economy of the country. The development of small and medium-sized businesses in Russia is a strategic direction for the development of the economy. Through their development, a favorable economic environment is developing, competition among commodity producers is increasing, new jobs are emerging, and market relations are developing as a whole. However, the development of small and medium-sized businesses is inevitably accompanied by a number of problems, including lack of financing, corruption, instability in taxation and other. This institution needs to be developed because small and medium business provides high dynamics of economic growth, helps to solve the problems of economic restructuring, does not require large investments, provides employment for a significant proportion of the economically active

population and high labor productivity; contributes to the formation of a competitive environment and the establishment of a market equilibrium. In addition, due to smaller scale, small and medium-sized enterprises are able to respond more flexibly both to changing economic conditions, and to fluctuations in consumer demand, to changing the market situation, thereby giving the economy additional stability.

Thus, the strategy for the development of small and medium-sized businesses is a priority for the development of the economy today. A special role in supporting such business is played by the state, as the development of small and medium-sized businesses will solve the problems of unemployment, increase labor productivity, saturate the market with innovative innovations, and resolve issues related to the inflationary instability of the Russian economy.

**Keywords:** small business, medium-sized business, development, economy, enterprises, market.

UDC 336.018

## QUANTITY THEORY OF MONEY

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Money is the universal equivalent of the value of goods used in the exchange. With the advent of money and the development there of the theory that explains the essence of money; one of them is the quantity theory of money (QTM). [1]

The concept of the quantity theory of money began in the 16th century. As gold and silver inflows from the Americas into Europe were being minted into coins, there was a resulting rise in inflation. This led economist Henry Thornton in 1802 to assume that more money equals more inflation and that an increase in money supply does not necessarily mean an increase in economic output.

### *QTM in a Nutshell*

The quantity theory of money states that there is a direct relationship between the quantity of money in an economy and the level of prices of goods and services sold. According to QTM, if the amount of money in an

economy doubles, price levels also double, causing inflation. The consumer therefore pays twice as much for the same amount of the good or service.

Another way to understand this theory is to recognize that money is like any other commodity: increases in its supply decrease marginal value (the buying capacity of one unit of currency). So an increase in money supply causes prices to rise (inflation) as they compensate for the decrease in money's marginal value.

#### *The Theory's Calculations*

In its simplest form, the theory is expressed as:

$$MV = PT \text{ (the Fisher Equation)}$$

Each variable denotes the following: M = Money Supply V = Velocity of Circulation (the number of times money changes hands) P = Average Price Level T = Volume of Transactions of Goods and Services

The original theory was considered orthodox among 17th century classical economists and was overhauled by 20th-century economists Irving Fisher, who formulated the above equation, and Milton Friedman.

It is built on the principle of "equation of exchange":

$$\text{Amount of Money} \times \text{Velocity of Circulation} = \text{Total Spending}$$

Thus if an economy has US\$3, and those \$3 were spent five times in a month, total spending for the month would be \$15.

#### *QTM Assumptions*

In its most basic form, the theory assumes that **V** (velocity of circulation) and **T** (volume of transactions) are constant in the short term. These assumptions, however, have been criticized, particularly the assumption that V is constant. The arguments point out that the velocity of circulation depends on consumer and business spending impulses, which cannot be constant.

The theory also assumes that the quantity of money, which is determined by outside forces, is the main influence of economic activity in a society. A change in money supply results in changes in price levels and/or a change in supply of goods and services. It is primarily these changes in money stock that cause a change in spending. And the velocity of circulation depends not on the amount of money available or on the current price level but on *changes* in price levels.

Finally, the number of transactions (**T**) is determined by labor, capital, natural resources (i.e. the factors of production), knowledge and organization. The theory assumes an economy in equilibrium and at full employment.

The theory includes the assumptions imply that the *value* of money is determined by the *amount* of money available in an economy. An increase in money supply results in a decrease in the value of money because an

increase in money supply causes a rise in inflation. As inflation rises, the purchasing power, or the value of money, decreases. It therefore will cost more to buy the same quantity of goods or services.

Monetarists say that a rapid increase in money supply leads to a rapid increase in inflation. Money growth that surpasses the growth of economic output results in inflation as there is too much money behind too little production of goods and services. In order to curb inflation, money growth must fall below growth in economic output.

Monetarists believe that money supply should be kept within an acceptable bandwidth so that levels of inflation can be controlled.

Less orthodox monetarists, on the other hand, hold that an expanded money supply will not have any effect on real economic activity (production, employment levels, spending and so forth). But for most monetarists any anti-inflationary policy will stem from the basic concept that there should be a gradual reduction in the money supply. Monetarists believe that instead of governments continually adjusting economic policies (i.e. government spending and taxes), it is better to let non-inflationary policies (i.e. gradual reduction of money supply) lead an economy to full employment.

#### *QTM Re-Experienced*

John Maynard Keynes challenged the theory in the 1930s, saying that increases in money supply lead to a decrease in the velocity of circulation and that real income, the flow of money to the factors of production, increased. Therefore, velocity could change in response to changes in money supply. It was conceded by many economists after him that Keynes' idea was accurate.

QTM was very popular in the 1980s among some major economies such as the United States and Great Britain under Ronald Reagan and Margaret Thatcher respectively. At the time, leaders tried to apply the principles of the theory to economies where money growth targets were set. However, as time went on, many accepted that strict adherence to a controlled money supply was not necessarily the cure-all for economic malaise. [2]

#### *The position of financial policy in Russia*

Modern monetary policy in Russia is based on scenarios that imply a direct dependence of the money supply and inflation. The Central Bank, firstly, is not interested in the growth of the real economy, and, secondly, to reduce inflation, it constantly maintains a high interest rate, including a mechanism for reducing the supply of money.

The economy of high rates is inevitably adjusted to bubbles, speculation, corruption, import dependence, low entrepreneurial activity.

That is, the Central Bank falls into a vicious circle, from which it is impossible to get out, still adhering to the liberal recommendations of the Washington consensus and the IMF consultants. To solve this systemic error in economic policy, one has to go beyond the current economic system, namely, the two tunnel scenarios. [3]

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**Аннотация.** В данной статье описана количественная теория денег, формула, по которой эта теория объясняется (теоретические расчеты, представленные тождеством Фишера), допущения теории. Так же приводится объяснение инфляции, взгляды монетаристов на количественную теорию денег. Описана критика теории в 1930-е года Джоном Кейнсом, возвращение к данной теории в 80-е года. Еще в данной статье представлено отношение к количественной теории в некоторых крупных экономиках стран, таких как США и Великобритания, как отдельный пример - Россия, финансовая политика России.

**Ключевые слова:** количественная теория денег, Дж. М. Кейнс, финансовая политика, Россия, деньги, тождество Фишера, инфляция, денежная масса.

**Summary.** This article describes the quantitative theory of money, the formula by which this theory is explained (theoretical calculations presented by the Fisher Equation), assumptions of the theory. Also provides an explanation of inflation, the views of the monetarists to the quantity theory of money. The critique of the theory in the 1930s by John Keynes and the return to this theory in the 80s are described. This article presents the attitude to the quantitative theory in some large economies of countries, such as the United States and the United Kingdom, as a separate example - Russia, financial policy of Russia.

**Keywords:** quantity theory of money, J. M. Keynes, financial policy, Russia, money, the Fisher Equation, inflation, amount of money.

## **PERSONAL BRAND AND BUSINESS DEVELOPMENT ON THE INTERNET**

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***"If your business is not on the Internet, you do not have a business"***

***Bill Gates***

In the modern world there are more questions than answers. The information age is continuing and, in my opinion, it has not even entered the active stage of development. Many people are willing to pay a very large amount of money for knowledge that can solve their problems.

Our world has changed a lot! We do not release smartphones all day long. In a restaurant or in a taxi, when we watch football or walk in the park, we always have access to the big world through the screen of our smartphone.

And this opens up new opportunities in the business sphere! A new class of entrepreneurs is already flourishing! These are not those who bought wholesale, but sells retail with a surcharge of 40%. These people are basically different from ordinary entrepreneurs. They have a superstrong understanding of marketing and online sales. They can easily make \$ 50,000 for 10 days via the Internet, without leaving any exotic island.

Statistics say that 30% of online orders are made through mobile devices. Every businessman makes an application for his business, and those who ignore it will very much regret in the future, because they simply lose customers.

There are several concepts that will help create a personal brand on the Internet:

First, you need to become an expert in your niche.

Before becoming a brand, an entrepreneur is obliged to become an expert in his topic. Expertise is the No. 1 problem for those people who are entering the market today. An expert is a person who has great knowledge

and skills in his niche. He is so deeply immersed in his subject as no one else. An expert is a person who teaches how to achieve results, where to start and how to scale. Marketing today is learning. It is necessary to give knowledge to other people. The mission of the expert is to influence other people so that their lives change for the better. Because influence is the most important currency [1, p. 292].

Secondly, the use of content marketing.

An entrepreneur must be registered in four main social networks: Vkontakte, Facebook, Instagram, YouTube. Content marketing is to broadcast your entire life into social networks. People are interested in watching movies, TV shows. Social networks should be an interesting series for people. People are interested in watching active people. Those who do sports try something new. Broadcasting - conducting live broadcasts, conducting webinars, writing articles and posts, publishing photos [2, p. 35].

Third, inspire others to change their lives.

Great marketers of the West are trying to convey to all entrepreneurs: people do not just buy the product and the opportunities given. People will buy the way of life that a person lives by. Therefore, it is necessary to engage in personal development. Constantly study in the field of marketing. Continually learn new skills.

Fourthly, the creation of stories.

The fourth principle of genius marketing is a personal story. Today, there are more and more people who can be potential clients, candidates, partners. It is important for them to understand what kind of people we are. And it is important for potential customers to understand that entrepreneurs are ordinary people. That's why many years ago Donald Trump began writing books and telling his stories about how he built one skyscraper, the second. That's why Richard Branson began to lead a public life by creating the company "Virgin" - began to write books and appear in the media. For example, Brandon Brushar, one of the best Internet entrepreneurs, has been telling the same story over the past four years about how he got into a car accident. How he came to, and everything around him was in blood. And he began to ask himself questions: "Did I even live before that? I loved? What is my general attitude to this world? "As he realized that at some point his life could be cut off.

This builds relationships with your potential audience. History should go from minus to plus. In America it is believed that there are three levels of content. The first level is the creation of only useful content. The second level is 30% of personal stories and 70% of good. And the third level is just broadcasting your personal life [1, p. 113].



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**Аннотация.** Целью данной работы является открытие современным предпринимателям возможностей построения и продвижения своего бизнеса в интернете. Доклад посвящен личному бренду и контент маркетингу, потому что сейчас это наиболее эффективный способ построения бизнеса. Особое внимание в работе уделяется созданию своих личных историй и транслированию их в Интернете через социальные сети. Потому что истории помогают создать доверительные отношения с потенциальными клиентами и продать свой продукт через личный бренд.

**Ключевые слова:** маркетинг, социальные сети, личный бренд, предприниматель, контент.

**Summary.** The purpose of this work is to open to modern entrepreneurs the opportunities to build and promote their business on the Internet. The report is dedicated to the personal brand and content marketing, because now it is the most effective way of building a business. Particular attention in the work is paid to the creation of their personal stories and broadcasting them on the Internet through social networks. In conclusion it should be noted that stories help create a trusting relationship with potential customers and sell your product through a personal brand.

**Keywords:** marketing, social networks, personal brand, entrepreneur, content.

UDC 336.743

## THE DIFFICULTIES IN IMPLEMENTING AND USING CRYPTO CURRENCY

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Crypto currency is a kind of money, an innovative achievement of recent years. For a few years, the Crypto currency has managed to reach its peak of popularity, surpassing the reliability of investments even dollars.

Speaking about money, it is worth mentioning that they appeared at the dawn of civilization. Money is a means of exchange and a means of accumulating wealth.

In 1944, after the Breton Woods Conference, the nature of money changed [1]. After this landmark event, many countries agreed to bind their national currencies to the US dollar, and not to gold or silver. In 1971, the US ceased to tie the dollar to gold. Now the Central Banks can, at will, increase or decrease the money supply. This gives them control over economic activity.

Most of the money transactions are connected with banks and national currency systems. The appearance of the crypto currency allowed carrying out transactions without intermediaries. For many users of the network, it has become the main instrument for investment, a reliable tool for making payments and transfers [3].

Crypto currency is a digital currency, the unit of which is a coin. The coin is a computer code that is copy-protected. The issuance of the crypto currency there is not in the bank that issues money, but directly in the network.

The key feature of the crypto currency is the absence of any internal or external administrator. Therefore, banks, tax, judicial and other public or private bodies cannot influence the transactions of participants in the payment system [2].

One of the first decentralized currencies is Bitcoin (see drawing 1). It appeared in 2009. The description of the crypto currency was published by Satoshi Nakamoto.



Drawing. 1. Dynamics of changes in the values of an ounce of gold and bitcoin coins in early 2017

Among the financial and tax authorities of different countries there is as yet no common position on how to treat transactions with the crypto currency. In Japan, Bitcoin is a legal tender with a tax on their purchase. In China, bitokoy operations are prohibited for banks, but are allowed for individuals.

Nowadays, more and more people choose crypto currency as an investment object. Simple users are attracted by the anonymity of transactions, high speed and convenience of transactions. However, the crypto currency has a lot of shortcomings. Such are: unstable exchange rates, a greater threat of hacking and fraud [3].

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**Аннотация.** Автор рассматривает сложности внедрения и использования криптовалюты. Криптовалюта – разновидность денег, инновационное достижение последних лет. Появление криптовалюты позволяет осуществлять транзакции без посредников. Эмиссия криптовалюты происходит не в банке, выпускающем в обращение деньги, а непосредственно в сети. Одной из первых децентрализованных валют считается биткоин. Он был создан в 2009 году. У криптовалюты есть множество недостатков, однако, ее по-прежнему выбирают в качестве объекта инвестирования.

**Ключевые слова:** деньги, криптовалюта, транзакции, инвестирование, посредник, валютные системы.

**Summary.** The author considers the difficulties of introducing and using crypto currency. Crypto currency is a kind of money, an innovative achievement of recent years. The emergence of crypto currency allows transactions without intermediaries. The issuance of the crypto currency there is not in the bank that issues money, but directly in the network. Bitcoin is considered one of the first decentralized currencies. It was established in 2009. The crypto currency has many shortcomings, but it is still being chosen as an investment object.

**Keywords:** money, crypto currency, transactions, investing, intermediary, currency systems.

## **CORRUPTION PROBLEM IN ECONOMY**

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In Russia the sociological research concerning a corruption problem as a social problem has been conducted. This survey was conducted among citizens of the Russian Federation of 18 years and is more senior, and according to statistical data, has been revealed that corruption level in Russia is – 72,2%. “But the saddest result from this poll is that fight against corruption happens only in words, there are no real changes connected with the solution of this problem” [1, www].

Corruption is today one of the most current and topical problems as corruption slows down development not only the Russian economy, but also world economy in general. Corruption — the term designating usually use by the official of the powers of authority and entrusted him is right for personal benefit, contradicting the legislation and moral installations. Most often the term is applied in relation to officialdom and political elite.

Today, according to Russians, the main corrupt officials in Russia are: employees of traffic police (43%), employees of police (39%), employees of customs service (35%), officials of regional and local authorities (33%). “All bureaucratic power of Russia is in serious and disease state. Therefore studying of this "disease" will be always demanded, and it is better — to find medicine for this disease” [2, p. 80].

It is possible to tell that corruption is present practically at all spheres of life of society. Therefore this economic problem is relevant for our country for many years. Manifestation of corruption in Russia is unique and differs from her manifestation in other countries. Corruption manifestations do huge harm to an economic field of activity of the state and society.

The government considers important aspect of fight against corruption salary increase to officials, the motivation of the employee directly depends on it. If the place at him already "grain", but also prison term shines even

for a bribe in several dollars – here he ten times will think before taking superfluous.

In the social sphere negative consequences of corruption are as follows:

Corruption assumes essential difference between the announced and actual values and forms at members of society "double standard" morals and behavior. It leads to the fact that money becomes a measure of all in society, the importance of the person is defined by the size of his private means irrespective of ways of his receiving, there is a devaluation and demolition of civilized social regulators of behavior of people: moral standards, right of religion, public opinion.

If to speak about the international practice of fight against corruption, but it is possible to give Singapore where corruption has stopped being norm of public life as an example. It is one of the Asian countries where this problem has been completely eradicated from outlook of the Singapore population. Fight against corruption in Singapore has begun since 1871, but only in 1961 it has been "completely destroyed". The principal anti-corruption organ of Singapore – Bureau on corruption investigation – applied drastic measures on fight against corruption, the penalty reached up to 100 thousand Singapore dollars and the bribe taker was brought to trial up to 5 years. It, really, is a historical example of fight against bribery for all countries including Russia [3, p. 632].

It would be desirable to note one more method of fight – it is necessary to place enormous emphasis on the sphere of Education, but not to allocate residual funds from the budget of the state for education. "In Russia according to the most conservative estimates, illiterate are more than two million teenagers. And there can't be a place to successful and effective development of economy" [4, www]. If it was heavy to find the illiterate person as all responsibility for education of the population was undertaken by the state, then now we observe the fact that in education the rich sector of society pays for obtaining the "artificial" diploma in the Soviet Union 30 years ago, taking jobs, not having a certain knowledge base. But the clever and well-educated person is in job search. Corruption stops education process, the state has practically removed from itself obligations for training of the population. The certificates in this case are the beggarly salaries of teachers, lack of financing of educational institutions and already since kindergartens, lack of places for students.

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**Аннотация.** В данной статье рассмотрена проблема коррупции с экономической точки зрения. В последнее время очень часто приходится слышать об этой проблеме, поскольку она прерывает дальнейшее развитие экономики.

Проанализированы последствия коррупции, касающиеся России, и выявлена опорная точка для борьбы с ней. Путем рассуждений и результатов исследований определен комплекс действий и мер, направленных на обеспечение и развитие экономической безопасности страны.

**Ключевые слова:** коррупция, уровень коррупции, борьба с коррупцией, теневая экономика, экономика, противодействия коррупции, план противодействия коррупции, высокий уровень коррупции

**Summary.** In this article the corruption problem from the economic point of view is considered. Recently very often it is necessary to hear about this problem as it interrupts further development of economy.

The corruption consequences concerning Russia are analyses and the reference point for fight against her is revealed. By reasoning and results of researches the complex of the actions and measures aimed at providing and development of economic security of the country is defined.

**Keywords:** corruption, corruption level, fight against corruption, shadow economy, Russian economy, world economy, anti-corruption, plan of anti-corruption, high level of corruption

UDC 657.632

## **SOCIAL REPORTING OF THE COMPANY AS ONE OF ELEMENTS OF AN INTEGRATED REPORTING**

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Among Russian companies, social reporting is becoming increasingly popular. The social report is a tool that allows you to inform users of the pace of implementation of the company's strategic objectives, its core mission, social well-being, economic stability and environmental stability. The main goal of social reporting should be to ensure transparency of activities, which is the main goal of business's social responsibility. The main principles of preparation of social reporting are the following:

- thoroughness and neutrality;
- comparability and compatibility;
- integrity and validity;
- expediency and regularity;
- sequence;
- continuous improvement.

The effectiveness of social activities of the company can be represented by such a set of indicators:

- with respect to labor and its safety: the total number of employees by type of employment, grouped by age, sex, including the number of disabled employees at the enterprise; staff turnover; types and amount of payments and benefits that are provided to employees;

- regarding the T&E activities and capabilities that are provided to staff: the average number of hours of training (in-service training) per employee per year by employee category; the number of ongoing programs of professional development, development of career skills, etc., and the amount of expenditures spent for the relevant purposes.

However, the problem is that at present there is no single body or single standards for the preparation of corporate social reporting [1]. As a result, social reporting of companies has different content, format and structure of the presentation, which complicates the processes of its reading and comparison. So, for example, the company of IDGC of Siberia, which provides electricity supply, submits the following information in its social report:

- distribution of employees by sex, % (workers: 47.5% of men and 5.1% of women, specialists: 18.5% of men and 14.7% of women, managers: 12.2% of men and 1.8% of women);

- information on the average wage of employees of IDGC of Siberia and average wages in the regions of presence (an average of 41.5 thousand rubles for workers of IDGC of Siberia and 29.7 thousand rubles for salaries in the regions of presence);

- information on injuries (number of injured, minor injuries, serious injuries, fatal injuries).

As a rule, Russian documents that play the role of a standard that regulates socially responsible behavior for companies are recognized the following:

- The Social Charter of Russian Business, created by the Russian Union of Industrialists and Entrepreneurs (RUIE);

- Code of Business Ethics of the Chamber of Commerce and Industry of the Russian Federation (RF CCI) "Twelve principles of doing business in Russia";

- Memorandum on the principles of corporate social responsibility from the Association of Managers of Russia;

- Standard "Social responsibility of organizations. Requirements" (CSR-2008) from the Russian Organization for Quality;

- "Basic performance indicators", formed by the RUIE in addition to the Social Charter [2];

- "Social responsibility of enterprises and organizations registered in the Russian Federation. Guidelines". From the RF CCI.

As before, many Russian companies create reports in the form of free content brochures. However, free reports are not able to ensure the reliability of information and comparability with similar documents. Therefore, free reporting can not be recognized and evaluated by international organizations. The bulk of large companies conduct annual report preparation according to recognized international standards. In the practice of international reporting, there are such standards for the compilation of social reporting [4] (Table 1).

Table 1 - Standards for the preparation of social reporting

AA1000 AS	Standard of social reporting of companies	is aimed to measure the performance of companies from an ethical standpoint and provides a procedure and a set of criteria by which social and ethical audit of their activities could be carried out.
ISO 26000	Guidance on social responsibility	provides guidance on principles underlying social responsibility, the main topics and issues related to social responsibility, and ways to integrate socially responsible behavior into the strategies, systems, practices and processes of the organization. This International Standard emphasizes the importance of results and improved performance.



Table continuation

Social <u>Accountability</u> <u>8000</u>	The standard of corporate social responsibility	distinguishing characteristic of the standard is its narrow focus on the observance of human rights by companies and improvement of working conditions for employees.
GRI (The Global Reporting Initiative)	Guidance on reporting on sustainable development of the Global Reporting Initiative	allows the reporting organization to use the recommendations in stages. That is, a company that is only on the path of reporting on sustainable development, can at first use only the general principles of the document. GRI also provides the possibility of preparing a report only of one or several areas of the organization's activities with a gradual extension to other areas.

In the National Register of Non-Financial Reports 161 companies were registered, 688 reports issued since 2000 were registered there. Among them: environmental reports (ER) - 53, social reports (SR) - 284, reports in the field of sustainable development (SD) - 222, integrated reports - 105, industry reports - 24 (Table 2).

Table 2– Distribution of reports of companies by industry affiliation (as of April 5, 2017)

Industry affiliation of companies	Number of companies	Number of reports				
		IR	SD	SR	R	Total
Oil and gas	19	2	92	9	36	139
Power Engineering	41	66	48	43	5	162
Metallurgical and mining	18	7	32	50	2	91
Manufacture of machinery and equipment	2	8	0	0	0	8
Chemical, petrochemical, perfumery	12	29	14	20	1	64
Woodworking, pulp and paper	4	0	0	4	18	22
Manufacture of food products	9	0	20	22	0	42
Telecommunication	10	4	6	20	0	30

Finance and Insurance	18	3	17	62	0	82
Housing maintenance and utilities board	5	1	0	13	1	15
Cement production and construction	2	0	1	0	1	2
Education, health	5	0	0	12	0	12
Transport	5	0	5	10	4	19
Other services	5	0	8	5	0	13
Non-Profit Organizations	5	0	5	21	0	26
TOTAL	160	120	248	291	68	727

The system for the preparation of social reporting is still of little use in Russia. And, first of all, this is due to the lack of necessary experience and the lack of experienced specialists. The increase in the number of companies (worldwide) that publish integrated reporting shows a strong increase in interest in this type of reporting. According to the IIRC (IIRC - International Council for Integrated Reporting), as of December 2015, over one thousand companies have joined the international project of integrated reporting.

Analyzing data on the number of companies that compose and publish integrated reporting from 2011 to the present, it is possible to record the multiple growths of organizations participating in the IIRC project. These data reflect a global trend aimed at increasing the transparency of companies, disclosure of not only financial, but also non-financial indicators. Preparation of integrated reporting is currently one of the most significant trends in the field of disclosure of information about the activities of the organization. The following guiding principles underlie the preparation and presentation of the integrated report, the presentation of the report content and the way information is presented [3]:

- strategic focus and orientation to the future,
- coherence of information,
- interaction with stakeholders,
- relevance,
- brevity,
- reliability and completeness,
- constancy and comparability.

Also in Russia there is a good potential for a full transition to integrated reporting: 12.7% of companies are already trying to prepare it, and 78.6% have a ready base for switching to this type of reporting. Basically, integrated reporting is needed for large companies to attract

additional investment. When the holding company includes more than 30 subsidiaries, it is very difficult to draw conclusions on its development and growth solely on the basis of regulated reporting. For investors, it is necessary to show the scope of activity and create an aggregate picture of the company's work in all spheres of its influence: social, environmental, financial. And, of course, knowing full information, investors will be able to assess whether your company is worthy of investing funds.

According to the Russian Regional Network (RRN) for integrated reporting, by the year 2025, already 400 companies will provide integrated reporting as the main document on the results of operations. The annual increase in the number of such companies will be about 35 new participants in the network of the RRN. This is due to the fact that the availability of such reports will gradually be included in the list of mandatory requirements for the provision of information about the company. For example, in the list of listing requirements presented by stock exchanges to its participants.

Thus, we can conclude that integrated reporting is in the development stage. It helps to reflect the focus of the target audience on investment, aims at future changes in the structure of the reporting and increases the company's value in the market.

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**Аннотация.** Рассмотрены проблемы внедрения интегрированной отчётности в Российской Федерации. Раскрыта сущность, определены цель и описаны основные принципы составления социальной отчетности. Поднята проблема отсутствия нормативно-правового регулирования составления и предоставления социальной отчетности, что приводит к недостаточно высокому уровню доверия к данным

социального отчета. Раскрыта информация о международных стандартах, регулирующих составление социальной отчетности. Также приведен анализ данных о количестве российских компаний, которые составляют социальную отчетность, и сделан вывод о текущем уровне развития интегрированной отчетности в России.

**Ключевые слова.** Корпоративная социальная отчетность; принципы социальной отчетности; показатели результативности социальной деятельности компании; стандарты социальной отчетности; интегрированная отчетность.

**Summary.** The problems of introduction of integrated reporting in the Russian Federation are considered. The essence is revealed, the purpose is defined and the basic principles of drawing up of the social reporting are described. The problem of lack of legal regulation of compiling and providing social reporting is raised, which leads to an insufficiently high level of trust in the data of the social report. The information on international standards governing the compilation of social reporting is disclosed. The analysis of data on the number of Russian companies that make up social reporting is also given, and a conclusion is made about the current level of development of integrated reporting in Russia.

**Keywords.** Corporate social reporting; principles of social reporting; indicators of the social performance of the company; standards of social reporting; integrated reporting.

UDC 336.74

## **WHAT IS CRYPTO CURRENCY: 21<sup>ST</sup> CENTURY UNICORN – OR THE MONEY OF THE FUTURE**

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In Russia, there is a boom in interest in new technologies in the financial sector: about cryptocurrency and mining say even the top officials

of the state. So, recently it became known that the state will regulate the production, as well as the processes of production and circulation of cryptocurrencies. We offer to understand the new terminal and find out what caused the surge of government interest in the IT-industry.

Cryptocurrency is digital money or in other words a cryptocurrency called a special kind of electronic means of payment. Strictly speaking, it is a mathematical code. It is called so due to the fact that when applying these digital money are used as cryptographic elements, namely an electronic signature. The unit of measurement in this system is considered to be "coins" (literally – "coins"). Cryptocurrency has no real expressions such as metal coins or paper bills. This money exists only in digital form. The principal feature that distinguishes cryptogenic from the real is the way they arise in the digital space. Thus, real means of payment are required to be made first to a certain account or e-wallet, and cryptocurrency units appear already in electronic form.

"The release" of digital money takes place in various ways: IPO (initial placement of coins, investment system), mining (maintenance of a special platform for creating new crypto-money), and forging (formation of new blocks in existing cryptocurrencies). It is a cryptocurrency literally arises "from the Internet".

Money differs from the usual digital in two settings. First, they are independent, imitating real money has the right exclusively to the Central Bank, but to produce crypto money – any person. In order to make transactions using cryptocurrency, you do not need to contact any third-party organizations (banks). Payments using digital money is carried out in the same way as conventional electronic transfers via the cashless payment system. The exception is that the exchange, through which crypto-money can be monetized, that is, transferred to the usual means of payment. The circulation of such currency is on the system of "blockchain" (literally "closed circuit" in English). This system is a database distributed to millions of personal computers around the world. At the same time, storage and recording of information when handling crypto money occurs on all devices at once, this guarantees absolute transparency and openness of transactions.

Secondly, they're virtual. Cryptocurrency exists only in the digital space and is stored in an electronic wallet.

The popularity of the cryptocurrency is due to the demands of the time. In the age of widespread dissemination of information technologies, universal means of payment, which could be calculated in electronic space without reference to a particular country or institution, are in great demand. This means and became a cryptocurrency. The reason for the popularity of bitcoin, NES Finance Professor Oleg Shibanov sees in the fact that the

participants of the system recognized the "real advantages" of the cryptocurrency system, namely "relative speed", "low cost of payments" and "lack of financial intermediaries" [1]. Oleg Ravnushkin, managing partner of Binomial Ventures Fund, shares Shibanov's opinion. "The process of transfer takes a few minutes and costs ten times cheaper than Bank", - said the expert in an interview for "Medusa" [3].

In this regard, the state's heightened interest in digital technologies in the field of Finance seems natural: the government is trying to keep pace with progress. At a meeting with the government, which took place on October 10 in Sochi, Putin said that "modern technologies in the banking sector open up new opportunities for organizations and citizens, make economic activities more convenient." [2]

But there is another reason for the government's attention to the problem of cryptocurrencies. To date, the legal status of virtual money is not defined, which means that the purchase and use of crypto money is not officially prohibited, but not allowed. The calculations bitcoin — the dark forest to the state power structures, so the possible exchanges illegal transactions. At the same meeting, Putin pointed to cryptocurrency risks, including circumvention of tax legislation, the financing of terrorism and the spread of fraudulent schemes.

The most common type of cryptocurrency: Bitcoin (BTC, bitcoin, currently one bitcoin is equivalent to \$ 4,200). Cryptocurrency bitcoin in simple words is the very first digital currency, on the basis of which all subsequents were developed. Bitcoin developer (group of developers) is Satoshi Nakamoto. For this currency, the limit on the number of 21 000 000 is declared, however, currently it is still not reached, so the cryptocurrency is a limited cash reserve.

According to its main characteristics, digital money is largely different from the usual. This entails not only advantages but also some disadvantages for users.

Advantages:

1. There are practically no commissions in transactions, since the role of a third party of relations – banks is excluded from operations with the help of cryptocurrency. Consequently, such payments are relatively cheaper than using conventional cash.

2. The decentralized issue, in addition to the possibility of extraction of money by everyone, causes the lack of control over this process.

3. All operations with cryptocurrencies (so-called transactions) are completely anonymous. The only open information in this case is the number of the e – wallet. And all information about its owner is closed.

4. Cryptocurrency is protected by a unique code like an electronic signature, so it is protected from copying, and therefore it cannot be forged.

5. To get that kind of money with the help of specially organized activity (mining) can be anyone. Since there is no single emission center and no controlling this process of bodies, then nobody can prevent to get cryptogenic in the network to ordinary citizens.

Disadvantages :

1. If the user has lost the password from your e-wallet, which means for him the loss of all the funds. Since there is no control over transactions using digital money, there are no guarantees of their safety.

2 .Cryptocurrency is characterized by high volatility due to the specifics of its circulation (volatility means a frequent change in its value).

3. In respect of cryptocurrencies, attempts can be made to various negative impacts by national money circulation regulators (for example, the Central Bank of the Russian Federation).

4. Since the process of getting amount of crypto coins more and more complicated, mining equipment of individual users becomes less profitable.

### **Conclusions:**

- If the trend continues, the average person will not be able to afford to purchase one whole bitcoin in 2 years. As global economies inflate and markets exhibit signs of recession, the world will turn to Bitcoin as a hedge against fiat turmoil and an escape against capital controls. Bitcoin is the way out, and cryptocurrency as a whole is never going away, it's going to grow in use and acceptance as it matures.

- Markets are dirty. But this doesn't change the fact that cryptocurrencies are here to stay – and here to change the world. This is already happening. People all over the world buy Bitcoin to protect themselves against the devaluation of their national currency.

- The emergence of Bitcoin has sparked a debate about its future and that of other cryptocurrencies. Despite Bitcoin's recent issues, its success since its 2009 launch has inspired the creation of alternative cryptocurrencies such as Litecoin, Ripple and MintChip. A cryptocurrency that aspires to become part of the mainstream financial system would have to satisfy very divergent criteria. While that possibility looks remote, there is little doubt that Bitcoin's success or failure in dealing with the challenges it faces may determine the fortunes of other cryptocurrencies in the years ahead.

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**Аннотация.** Данный доклад посвящен биткоину, как наиболее популярному виду криптовалюты, так и одноименной платёжной системе. Цель исследования – выделить преимущества криптовалюты и попытаться найти причины её популярности, так как на данный момент криптовалюта не контролируется Центральным банком. Особое внимание уделяется процессу производства, майнингу, а также правовому статусу криптовалюты.

**Ключевые слова:** криптовалюта, биткоин, майнинг, электронные деньги, электронный кошелёк.

**Summary.** This report is devoted to bitcoin as the most popular type of cryptocurrency and the eponymous payment system. The purpose of the study is to highlight the advantages of this cryptocurrency and try to find the reasons for its popularity, since at the moment the cryptocurrency is not controlled by the Central Bank. Special attention is paid to the process of its production, mining, as well as the legal status of cryptocurrency.

**Key words:** crypto currency, mining, digital money, electronic wallet, bitcoin.

UDC 330.15

## PROBLEMS OF THE POPULATION AND NATURAL RESOURCES

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The problems of the economy are global violations in the development and conduct of economic activities of individual countries or the world. As a rule, the global economic problems include the division of the community into development poles, the depletion of the planet's resources (including water resources), food problems, poverty, weak scientific and technological progress and so on [2].

In our report the problems of the population and natural resources are considered.

Simple numerical growth of the population does not necessarily mean development.

We see that many underdeveloped countries follow the same path as Europe's economic development in the 18th and 19th centuries: the progress of medicine primarily reduces the mortality rate; and as the birth rate remains high, the population is rapidly increasing.

Since labor is an important factor in production, a lot can be done in this area through constructive programming. When planners make projects for accelerating economic development, they plan the following special programs:

1. Fighting diseases, expanding health care and improving nutrition. This is necessary both to make people happier, and in order to increase the productivity of their work. Therefore, hospitals and sewerage should not be considered a mere whim or luxury.

2. Inclusion in the budgets of expenditures for schools and other programs is designed to reduce illiteracy. It is necessary to train the population not only in reading and writing, but also in new agricultural and industrial equipment.

Let's consider hidden unemployment. An important source of development is the better use of human resources. In the poor, agrarian countries, it often happens that a significant part of the workforce is almost completely inactive, because it does not find application for itself. This part, perhaps, is not taken into account in the census of the unemployed, but it can hardly be included among the employed; these people live with their relatives, and when a boom or a development plan takes place, due to which they are drawn into productive work in cities, this does not cause almost any reduction in production in their village. The phenomenon of hidden unemployment is observed in advanced countries, both in poor agricultural areas and in cities where people are forced from bread to water, trading peddling in periods when they can not get productive work.

In order to solve the problem of unemployment and underemployment, governments often find it desirable to pursue fiscal and monetary policies, even by means of this policy creates problems of inflation and a balance of

payments deficit [1].

Poor countries, as a rule, are poorly endowed with natural resources, and the lands and minerals that they possess should be distributed among a highly crowded population.

Specialists in economic geography agree that further development is largely ensured by the best use of existing resources. Gone are the times of opportunities facing Columbus; and the time passed when the poor in the old areas lured open doors to the fertile steppes of North and South America or to the vacant areas of Australia and New Zealand.

So, even without mastering or opening up new lands, nations can better use their lands. The medieval village was divided into tiny stripes of the earth, on which it was difficult to turn. In many underdeveloped countries we observe another extreme: the landed estates are represented by huge ones so large to be effective.

The problem of the development of natural resources merges with the problem of improving technology and the problem of providing equipment and tools for the use and detection of these resources.

For years being as a part of the Russian Federation, Sevastopol population has grown by 11%. In 2014, when according the results of the referendum Crimea became part of Russia, the population of Sevastopol was 383 thousand people. By the end of 2016, 426 thousand people live in the city permanently. Thus, there is an increase in the population on 11%. The population of the country is decreasing, but in some regions there is a positive dynamics of population growth - like in Sevastopol, solely due to migration. This means that if people arrive somewhere it is exactly the same decrease in another place.

Consider the ground resources.

They are mainly used for food production. In Crimea, agricultural ground covers an area of about 1800 thousand hectares, or almost 70% of the total land area (including arable land, perennial plantings and pastureland). The rest of the ground is occupied by forests, shrubs, water features, ravines, sand or broken.

Among the variety of soil types of the peninsula in this indicator southern chernozem, meadow-chernozem and brown soils are considered to be the best. They are suitable for all cultivated crops.

It is such grounds that are under cultivation and produce high yields. In some central and western areas of the plain Crimea the share of ploughed ground is very high – 80-85% of the area of all ground. High ground development leads to one of many negative processes: water and wind erosion, waterlogging and salinization of soils in irrigation areas.

In conclusion it should be said that Despite the fact that every year in

agricultural production inconvenient ground (rocky places, salt marshes, saline soils with bushed ground and others) are involved, in general, the area of farmland is reduced due to the withdrawal of their industrial facilities, expansion of settlements, the construction of villas, roads, canals, etc.

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**Аннотация:** В статье рассматриваются вопросы развития двух главных факторов: населения и природных ресурсов. По мере экономического роста в странах будет производиться все больше товаров и услуг, что приведет к повышению местного благосостояния и потребления и истощению природных ресурсов. Население создает социологические проблемы, связанные с резким ростом его численности вследствие снижения смертности, не сопровождающееся одновременным снижением рождаемости. Резервы в форме «скрытой безработицы» в деревне и городе представляют важный источник рабочей силы для создания дополнительного продукта. В заключение дана характеристика ресурсов и населения, их изменение за годы нахождения Севастополя в составе РФ.

**Ключевые слова:** природные ресурсы, скрытая безработица, население, земельная форма, экономика.

**Summary:** The key to development is based on two main factors: the population, natural resources. The population creates sociological problems associated with a sharp increase in its number due to a decrease in mortality, not accompanied by a simultaneous decline in the birth rate. Reserves in the form of "hidden unemployment" in the village and city represent an important source of labor for the creation of an additional product. In conclusion, the characteristic of resources and population and their changes in Sevastopol during the years in the Russian Federation is given.

**Keywords:** natural resources, hidden unemployment, population, land form, economy.

## **PROBLEMS AND WAYS OF IMPROVEMENT IN LOGISTIC EXPENSES ACCOUNTING**

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Now in the conditions of market economy studying of logistic expenses of the enterprises and determination of their importance in the mechanism of pricing of goods, works and services is of special interest. The most important task of the company management is reduction of logistic expenses, which will bring in its turn decrease in the level of prices for logistic services of divisions, increase in the level of competitiveness and profitability of the enterprises.

The logistics of material flow also studies a complex of operations providing the flow of material objects and products of labour from primary source of raw materials to the end consumer. Decision-making on these operations from a position of interests of through system allows to speak about them as about logistic operations. Otherwise the adjective "logistic" will be inappropriate.

Use of the term "logistic operations" assumes an ultimate goal of logistic management - rationalization of through supply chains.

Logistic expenses (logistic cost) - costs of logistic operations.

Logistic operations with objects and products of work are carried out both in distribution, and in production. According to costs for performance of logistic operations include both a part of distribution costs, and a part of costs of production.

The main components of logistic expenses are:

- Transport and procurement expenses;
- Stocks.

The importance of reduction of these expenses by means of the system organization of processes are defined by that share which they take in a total amount of costs of production and distribution

The present stage of development of logistics is defined by two major factors: globalization of world economy and a global scientific and

technological revolution which generate new needs of clients for logistic services and various forms of their satisfaction.

Globalization of business is expressed by the following:

- more advanced communication and transportation have made physical distances less significant, thanks to it enterprises can work at the single covering the whole world market;

- there is a reduction of trade barriers between the countries and growth of international trade and the competition;

- placement of the enterprises is determined not by the national principle, but it tends to be located in the countries and regions of low costs of production (for example, the German enterprises in Poland, American - in Mexico, Japanese - in China).

As L.B. Mirotin notes, managing logistic expenses of the enterprise it is necessary to consider the high level of dynamics of market conditions, deficiency of means of payment, high level of competition, i.e. everything that influences efficiency of logistic activities. However, questions of optimization of logistic expenses still haven't become a subject of serious researches. The lack of evidence-based methodology of management of logistic expenses leads to the fact that still there are no reliable and efficient techniques of their planning, assessment and the analysis.

The concept of logistic expenses means expenses such as material, financial, labor, and information resources caused by implementation of orders of consumers, that is complex functioning of the enterprise.

At the aspiration of the management to increase efficiency of logistic systems, the great value is allocated to planning, accounting and reduction of logistic expenses. The share of these expenses in the general costs of production is very considerable and fluctuates from 10-15% in mechanical engineering up to 30-45% in the light and food industry.

Expenses in a logistics system are divided into two big groups:

- expenses connected with the organization of material flow in the enterprise;

- expenses which are carried out in the course of product sales.

Accounting of logistic expenses consists of summing up all expenses connected with process realization.

Traditional methods of accounting often don't provide the possibility of identification of all expenses connected with the process. The main reason is that accounting of expenses is carried out on certain functional areas whereas material flow passes "through" the organization, interacting with a set of divisions.

Traditional methods of accounting combine expenses in large units this doesn't allow to carry out the detailed analysis of expenses various by

origin, to consider all consequences of administrative decisions, and also their impacts on the corporate organization. As a result of the decisions made in one functional area bring unforeseen results in other adjacent areas.

The problems connected with the definition of total impact of the system of the movement of material flow on the general system of the enterprise are extremely various. The logistics by the nature "penetrates" the enterprise, making essential impact on a set of its subsystems, thus traditional accounting systems don't allow to define this influence, aggregating logistic expenses in other groups of corporate expenses. There is no decomposition of the process of goods supply on separate operations. The expenses connected with the general process consist of a set of the expenses arising in different spheres and it is quite difficult to integrate them into a single item of expenditure within functional and organized accounting.

For example, one of the enterprises of the food industry of Moscow having organized a goods supply of small retail chain stores used the following order. Orders of the outlets, which are on in advance established routes before loading were completed on commodity feature, i.e. the identical goods ordered by different shops gathered on one pallet (also other option of shipment when the different goods intended to one shop are gathered on one pallet is possible). Having arrived along a route to the next shop, the driver picked goods from different pallets and boxes (according to the order). Actually the complete set was carried out by the driver, the car stood idle at this time. The transport service of the plant convinced plant management of need of implementation of a preliminary picking of finished goods by the warehouse according to orders of separate shops. The main argument was increase in efficiency of transport usage. Picking was transferred to the finished goods warehouse; however, nobody at the same time considered increase of expenses and resources consumption.

Managing the process without knowing exactly how the resources are spent in the course of its implementation is to drive the car blindfolded.

Logistics provides operation-by-operation accounting of expenses on all the way of the movement of material flow. Existence of this accounting system allows to use an indicator of change of the sum of costs for process as criterion of efficiency of the made decisions in the sphere of management of material flows. Summing up the result, we will formulate the main problems connected with expenses in logistics.

— High share of costs of the operations connected with the flow of commodity and material resources in spheres of production and distribution, in a total amount of expenses. The constant, advancing general rate of inflation, growth of cost of labour on the majority of these operations;

— Absence, generally, at traditionally organized accounting criteria of decision-making on the rational organization of logistic process;

— Sharp growth of sensitivity of logistic expenses to change of quality indicators of work of logistics systems in the field of their quality functioning, characteristic of the competitive markets.

Accounting of logistic expenses has to be integrated with their rationing, planning and the analysis into the single information system allowing to reveal and eliminate quickly deviations in the course of logistic activity. At the same time issues of purchase of this or that production, production in this or that place, use of these or those distribution channels are resolved.

A. Smekhov specified that if to take costs of logistics as 100%, then the specific weight of separate components will be distributed as follows:

- transportation by the main transport - 28-40%;
- warehouse, loading operations and storage of freights - 25-46%;
- packing up to 15-25%;
- costs of management - 5-15%;
- other (including processing of orders) - 5-17%.

In the conclusion it should be noted that timely and full accounting of logistic expenses allows not only to save financial and a manpower resources, but also to considerably increase efficiency of all economic activity of the enterprise that in modern conditions of development of market system is one of indicators of financial stability and stable development of economic entity.

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**Аннотация.** В статье рассмотрены основные проблемы логистической деятельности на предприятии и, как следствие, - основные составляющие логистических издержек и пути глобализации бизнеса. Сформирован основной перечень логистических операций, которые могут препятствовать полноценному развитию производства

и тем самым вести к серьезным затратам. Представлены основные пути решения и совершенствования логистики на предприятии, а также основные требования к логистическим издержкам.

**Ключевые слова.** Логистика, издержки, глобализация бизнеса, затраты производства, логистические операции.

**Summary.** The main problems of logistic activity at the enterprise and, as a result, the main components of logistics costs and ways of globalization of business are considered in the article. The main leap of logistics operations is formed, which can impede the full development of production and thus lead to serious costs. The main ways of solving and improving logistics at the enterprise are presented, as well as the basic requirements for logistics costs.

**Keywords.** Logistics, costs, globalization of business, production costs, logistics operations.

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## **THE PROBLEMS OF THE TECHNICAL CHANGES AND INNOVATIONS**

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Any global problems affect the standard of living, the economies of countries and the world community as a whole. Therefore, all states are engaged in their decision, joining their efforts. Economic problems have recently become most pronounced [2]. These include the problems of the population, natural resources, overcoming poverty and others. These problems pose the question not only the development of the planet and each individual state in the economic sense, but the existence of mankind as a whole [3]. In our report we consider technical changes and innovations.

In addition to the main factors – the population, natural resources and capital formation, there is still a very important fourth factor – technology. Here we can proceed to a moderately optimistic tone. In this area, underdeveloped countries have one possible advantage. Undoubtedly, they



experience a sense of loneliness and fright in a world that is not created by them. But that's why they can hope to benefit by borrowing more advanced technology from developed nations.

Borrowing technology. New countries do not need to prepare yet unborn Newtons, in order to open the law of attraction: they can read about this law in books. They do not have to make a long, tortuous journey of the industrial revolution: in any catalog of cars they find miracles that no great inventors of the past dreamed of. Even in Canada, the population was dissatisfied with the large post-war investments of large US corporations and in 1961 special taxes were imposed on foreign capital.

The historical development of Japan and Germany is a good illustration of all this. At the end of the nineteenth century Japan entered the path of industrial development; it imitated the technique of the West and sent the students abroad. The government has taken an active and constructive role in stimulating the pace of development, building railways and public utilities and imposing high taxes on land, the value of which has been enhanced by improvements in agriculture. Few vigorous rich families were allowed to create vast industrial empires, while the entire population had to work hard to make a living. Almost without recourse to the import of foreign capital, Japan for several decades advanced to the front ranks as a military power and as an industrial nation.

Germany only after the revolution of 1848 really accelerated the pace of industrialization. As Torstein Veblen pointed out, England was, in a certain sense, at a disadvantage due to the fact that she had carried out an industrial revolution so early; this in many industries linked it with obsolete production methods. Arriving late, Germany did not encounter these obstacles. Thanks to government assistance to universities, science in Germany soon won an outstanding place in mathematics, physics, chemistry and engineering. Fifty years ago, most American professors in these fields of science, as well as history, economics and philology, traveled to Germany to obtain academic degrees. Germany's success in organic chemistry, optics, glass and electrical equipment remained unbeatable until two wars drove it back.

Finally, the United States itself provides the rest of the world with an example that reinforces an optimistic view on this issue. Until Hitler presented as a gift to many of the best European scholars of all faiths in the 1930s, we could not boast of having completely reached the very first row in the field of pure science. However, for a century, American applied technology, admittedly, occupied an outstanding place. The leading inventions in the field of automotive industry were presented by "Genry Ford" and "General Motors" [4].

Consider interaction of technology and capital. It is true that underdeveloped countries are borrowing advanced technology. But did we miss anything important? Does not advanced technology find its embodiment in the form of complex equipment? And have not we already seen that these countries lack capital? So how can we expect them to borrow the best technique?

Undoubtedly, these remarks are very fair. Technical changes and capital investments go hand in hand. Often they are inseparable from each other. And yet, we are doing the right thing, considering them as analytically distinct - although related to each other - processes. Here is one of many examples showing the reason for this.

In many backward countries, agriculture is inefficient. One can see there peasants who cultivate the land with the same primitive methods that their ancestors used during the times of the kings David and Solomon. Perhaps, it is possible to invent a cleverly designed lightweight and very cheap plow. This would reduce the total amount of necessary capital and greatly increase the output. It shows how technical innovations can often lead not to the expenditure of capital, but to its saving.

In addition, even in the poorest countries, there is always a certain gross capital formation, as the tools wear out and are replaced by a new one. Is it assumed that a significant part of the country's capital was directed to objects that simply reproduced exactly the old! Undoubtedly, it is much better to re-materialize the available new investment funds in the form of more effective technical adaptations. Thus, one can see how the interrelated factors of capital formation and technology can mutually reinforce each other.

And what about entrepreneurship and innovation? We greatly facilitated the task facing the economy of the underdeveloped countries, is not it? In order to achieve the development in a few years they have to do the following steps:

- go abroad and borrow from these countries effective methods;
- bring them to your country and put them into practice;
- fold your arms and wait for the additional product to appear by itself.

Of course, things are different. Peoples in underdeveloped countries know this from their own bitter experience. Nevertheless, one and the same illusion constantly arises among the peoples of the so-called advanced countries. We all too often think that it is enough to send several technicians to a small excursion to a poor country; having spent a month or so to inspect the field of activity, they can make their recommendations; then the purely

rewritten report on the typewriter, which they compiled, can be "implemented". And, thus, the problem of development is solved.

Sometimes, in connection with special technological processes, specialists really were able to perform miracles in such a pleasant and easy way; So, the American skin tanning specialist was sent to Libya for consultations in connection with some difficulties that arose, and in a short time he found the cause of the problems in the field of chemical treatment and proposed an effective way of eliminating them. However, engineers soon discover that such miracles are impossible when it comes to the development of the entire national economy. In fact, they are usually completely disappointed: after examining the underdeveloped country for several months, the expert is under the strongest impression of thousands of cultural and economic obstacles on the way to progress; the impression is so strong that he returns to his country, experiencing a hopeless sense of defeat. This pessimistic conclusion is in a certain sense probably as erroneous as the opposite optimistic illusion.

Experience shows that development is truly a painful and slow process. But it is feasible. To accelerate it, the spirit of entrepreneurship and innovation should spontaneously develop. Recall that many of these peoples begin to develop, which they often inherit from the colonial elite that once dominated them. Often also they are treated with contempt for commercial and industrial activities: to making money and producing. Gradually, they must create a creative group of manufacturers, within their own mixed cultural system, ready to introduce new ways of production without delay.

Why can one focus on creative innovation? Because the adaptation of advanced foreign technology for use in an underdeveloped country is by no means a simple matter. Recall that advanced technology itself was developed in accordance with the specific conditions of advanced countries. What are these conditions? High rates of cash wages; a small labor force, which, however, provides an abundant supply of skilled personnel; the abundance of capital inherited from past times; mass production, etc. Other conditions prevail in the underdeveloped country [1].

The experience has shown us: it is easy to obtain an external loan for the construction of a plant in Turkey or Burma. This plant is piecemeal imported from abroad and embodies the latest achievements of Western technology. And yet, what results will be? Does such a plant provide a high level of production and does the sales revenue exceed production costs, yielding sufficient profits that can be re-invested for further industrialization? This is very rare. Often such imported grandiose new buildings are unprofitable. The plant, which is optimal for New York, may fail in Ankara or Rangoon.

This task of creative innovation should not be resolved only on the paths of crude individualism. The government can do a lot by creating centers for popularization of agricultural knowledge in each province. These centers should advise the peasants on the application of the best seeds, methods of cultivation, tools and adaptations. By creating professional schools and courses for training in the handling of cars – as well as accounting, – the government itself can play a creative role as an innovator [5].

Today, the Republic of Crimea has almost 24 thousand active legal persons.

The tenth part of them (2,500) was registered in 2017. The number of liquidated organizations is approximately one and a half thousand. There is a natural increase: plus 1,000 companies. New firms are always emerging in the economy and old firms are being cancelled.

Also, the number of employees at the Crimean enterprises has grown. In January (2017) there were 354 thousand workers, in October – 419 thousand. This is not only the creation of new places, but also the legalization of old ones, the refusal of drab salaries. Two positive processes occur simultaneously. The increase in the number of employees is in all branches of the economy of the Crimea. The key drivers of employment growth are: agricultural enterprises created additional 8 thousand jobs, industry – 10 thousand, wholesale and retail trade – 17 thousand. As one can see, trade enterprises have made the most significant contribution to improving the situation on the labor market. In total, the number of employees in Crimean organizations increased by 65 thousand this year [7].

Minister of economic development (MAYOR) of the region Andrei Melnikov said that the economic growth of this year was estimated in 10%. Gross regional product is approaching to the border of 350 billion rubles. He stressed that Crimea this year showed a positive trend in all sectors of the economy due to investment.

The authorities of the Republic expected to attract 80 billion rubles this year, but in the first 9 months it is managed to attract 122 billion rubles. This is an investment of small and medium – sized businesses and another qualitative basis for the subsequent growth of the economy. The construction sector grew 3.4 times and the industry grew 2.3%. The economy of the Republic enters another phase of development.

In conclusion it should be noted that the share of agricultural enterprises in the production of agricultural products is growing. This means that in the Crimea there is a mass commodity production [6].

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**Аннотация:** В статье охарактеризованы технические изменения, которые взаимодействуют с новыми капитальными благами и воплощаются в них. Отмечено, что это особый процесс, который внушает большие надежды развивающимся странам, так как они могут заимствовать современную технику и технологию у передовых стран. В заключение отмечено, что одной из наиболее настоятельных задач является ускорение развития предпринимательского и коммерческого духа внутри страны. В настоящее время в Крыму появляется массовое товарное производство.

**Ключевые слова:** технические изменения, инновации, капитальные блага, промышленное развитие, капитал, индустриализация, инвестиции.

**Summary:** The article describes the technical changes that interact with the new capital goods and are embodied in them. It is noted that this is a special process that inspires great hope to developing countries, as they can borrow modern technology from advanced countries. The historical experience of Japan, Germany and the US is considered. In conclusion it is noted that one of the most urgent tasks is to accelerate the development of entrepreneurial and commercial spirit within the country.

**Keywords:** technical changes, innovations, capital goods, industrial development, import, capital, industrialization, investments.

## **INVESTMENT ATTRACTIVENESS OF THE TOURISM SECTOR IN THE REPUBLIC OF CRIMEA**

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The tourism industry is traditionally considered a strategic direction of development in the Republic of Crimea. It determines the stable competitive position of the region, its authority on the national and international market as well. However, the tourism sector in the Republic of Crimea is currently undergoing changes that occurred after joining the Russian Federation. The situation was made worse by the imposition of sanctions by the EU countries, the USA, Canada, Japan, Australia, which affected the most diverse aspects of the social life on the Crimean peninsula, including the investment attractiveness of tourism sector. In this regard, it is necessary to transform the procedures and mechanisms for attracting investments in the tourism industry of the peninsula.

**The purpose and tasks of the investigation.** The purpose is to analyze the investment potential of the tourism sector in the Republic of Crimea, taking into account modern socio-economic and geopolitical realities.

To achieve this purpose, it is necessary to solve the following tasks:

- to analyze the main economic indicators in tourism industry of peninsula, achieved in 2017;
- describe the implemented projects related to the development of tourism in the Republic of Crimea;
- assess the investment attractiveness of the tourism sector of the Republic of Crimea based on SWOT-analysis.

In 2017 the Republic of Crimea continued to build international and interregional relations. During the year, the Government of the Republic of Crimea implemented the set of measures to improve the investment climate and tourism attractiveness of the region.

By the present moment of time:

- the investment declaration of the Republic of Crimea was approved;

- The Council for the improvement of the investment climate in the region was established;
- the "Center for Investments and Regional Development" was formed, which provides advice for investors and support them during the implementation of investment projects;
- The Investment Portal of the Republic of Crimea started its activity.
- "Hot Line" on the issues of improving the investment climate in the Republic of Crimea was opened;
- a register of investment projects implemented in the territory of the Republic of Crimea was created [1].

As of 01.07.2017, 183 agreements on the implementation of investment projects in the Republic of Crimea were signed, totaling 197 billion 936 million. In 2016 95 projects were implemented, totaling 72 billion 242 million, and in 2015 - 52 projects, totaling 48 billion 864 million. Currently, 28 investment projects in the field of tourism, totaling 105 million, are monitored for its implementation [2].

As for the volume of tourist flow, 5 395.1 thousand tourists were rested in the Republic of Crimea in 2017, which is 3.2% below the level of previous year [3].

For January-July of 2017 tax revenues to the budget from the tourism industry amounted to 6.8 million rubles from the total 37.4 million rubles [2].

In 2017 the following accommodation facilities were opened in the Republic of Crimea:

- a building in the hotel "Mope" for 108 rooms with a medical building, conference rooms and an exhibition area of 500 square meters (Alushta);
- five buildings in the hotel complex "Yalta-Intourist" for 280 rooms (Green Park territory) [3].

In 2016 11 new hotels were opened and more than 20 sanatorium-resort and hotel establishments were modernized. [3]

Considering the fact that nowadays the main purpose of the arrival of most tourists is beach vacation (84.2%), the improvement of beaches, the vast majority of which is in terrible state, is of particular importance. So, in 2017, 285 agreements on the improvement of beaches were concluded [4].

Thus, based on the foregoing, it is possible to identify factors of investment potential and factors of investment risks that determine the investment attractiveness of the tourism sector of the Republic of Crimea. The results are displayed in the matrix of SWOT analysis presented in Table 1.

Table 1 - Results of SWOT-analysis of investment attractiveness of the

tourism sector of the Republic of Crimea

Strengths	Weaknesses
<p>1) Favorable economic and geographical position (access to the Black and Azov Seas, the presence of five sea ports: Kerch fish, Kerch, Feodosia, Yalta, Evpatoria);</p> <p>2) The effect of the preferential treatment of the Free Economic Zone within the whole territory of the Republic of Crimea;</p> <p>3) Favorable natural and climatic conditions and availability of recreational resources (therapeutic mud, mineral waters, etc.)</p> <p>4) A large number of cultural, historical and architectural heritage sites;</p> <p>5) Formed infrastructure of sanatorium and resort complex;</p> <p>6) The multi-profile nature of the tourism complex.</p>	<p>1) Problems of transport logistics, the difficult accessibility of the Crimean peninsula for potential tourists from Russia and foreign countries;</p> <p>2) Insufficient provision of the region with water, energy and food sources.</p> <p>3) The impact of economic sanctions that limit the influx of foreign and private Russian investments;</p> <p>4) High level of shadow economy;</p> <p>5) Seasonal nature of the work of industry enterprises;</p> <p>6) High level of depreciation of fixed assets.</p>
Opportunities	Threats
<p>1) The conclusion of new foreign economic and cultural agreements with the countries of the EAEU, the SCO, the CIS, Latin America, Africa, South-West and South Asia, the Asia-Pacific region; an increase in the volume of foreign direct investments in the economy of the Republic of Crimea and an increase in demand for Crimean resorts from the countries of these regions;</p> <p>2) Modernization of the transport and communal infrastructure of the Crimean peninsula at the expense of the Federal Target Program "Social and economic development of the Republic of Crimea and Sevastopol until 2020";</p> <p>3) Improving the transport accessibility of the region through the construction of a new airport terminal in Simferopol, the construction of the Kerch bridge.</p>	<p>1) The threat of preservation and further strengthening of trade, economic and financial sanctions;</p> <p>2) Reduction of investments from Russia in conditions of internal budget deficit;</p> <p>3) Absence of conditions for the timely formation of a favorable image of the region as an attractive tourism destination;</p> <p>4) Preservation and strengthening of the shadow economy in the tourism sector.</p>



Source: compiled by the author

Also, the annual Yalta forum is of great importance for increasing the investment attractiveness of the region, including the tourism sector. In 2017, the III Yalta International Economic Forum was held, it was attended by more than 1,500 people, including representatives of 50 countries. The result of the IIEF was the signing of a number of major agreements on the implementation of investment projects in the Republic of Crimea for the amount of about 100 billion rubles.

In this way, the tourism sector of the Republic of Crimea has a great potential for further development. In order to solve the problems mentioned in the SWOT analysis it would be important to provide state support aimed at improving the infrastructure of the industry and the transport accessibility of the region. Finally it will lead to increase of attractiveness of the region for investors. Also, it is crucial to establish economic and cultural cooperation with the countries of the EAEU, the SCO, the CIS, the Asia-Pacific region, South-West and South Asia, Africa and Latin America, which will increase the volume of direct foreign investment from the countries of these regions into the economy of the Republic of Crimea.

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**Аннотация.** В статье рассматриваются вопросы инвестиционной привлекательности сферы туризма Республики Крым и пути ее повышения. В ходе написания статьи проведен SWOT - анализ инвестиционной привлекательности Крымского полуострова и определены негативные факторы, влияющие на инвестиционный потенциал республики. На основании проведенного исследования предложены пути повышения инвестиционной привлекательности региона.

**Ключевые слова:** инвестиции, инвестиционная привлекательность, туристический сектор, SWOT-анализ, Крым.

**Summary.** The article deals with the issues of investment attractiveness of tourism sector in the Republic of Crimea and ways to increase it. During the writing of the article, a SWOT analysis of the investment attractiveness of the Crimean peninsula was carried out and negative factors influencing the investment potential of the republic were determined. Based on the conducted research, ways of increasing the investment attractiveness of the region are suggested.

**Key words:** investments, investment attractiveness, tourism sector, SWOT-analysis, Crimea.

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**MODERN INFORMATION TECHNOLOGIES AS A  
PRIORITY STRATEGIC DIRECTION OF DEVELOPMENT  
OF THE EURASIAN ECONOMIC UNION**

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Modern transformational processes of geopolitical space, the formation of a new world order correlate with the search for appropriate models of economic growth. In this context, one of the current leading trends is getting actualized: the strengthening of regional cooperation, that is, the formation and functioning of international integration associations of national states with similar interests and readiness to pool resources to achieve their goals. The rapid progress of information technologies (IT), the formation of the information society today occurs outside national borders and affects almost all social phenomena. The economic processes of integration associations are no exception.

On January 1, 2015, the Eurasian Economic Union (EAEU) was formed (Kazakhstan, Russia, Belarus, Armenia and Kyrgyzstan) – a promising association in the post-Soviet space, whose priority tasks are modernization and deep integration through comprehensive cooperation of the national economies of the EAEU partner countries for the purpose of steady development of economies, increasing their competitiveness and living standards of the population [1, p. 39; 2, p. 4]. This integration project is a regional entity whose economic interests are based on the possibility of merging Europe's technologies and the natural potential of Asia, and the

cooperation of countries, despite national specifics, is due to a certain geographic, legal, sociocultural community, and the interdependence and complementarity of national economies. Unification processes within the framework of the Union are aimed primarily at enhancing economic interaction and suggest not only formal integration, but also a genuine strengthening of various economic forms of cooperation – from traditional (mutual trade, financial-investment interaction, etc.) to innovations (development, use and commercial exchange of advanced production technologies with foreign countries, the introduction of the latest information, communication and digital technologies, software, computer facilities and services in these areas, etc.).

The close interconnection of the economy and information technologies in modern global economy has led to the emergence of such a phenomenon as the "information (digital, virtual) economy." The newest IT, representing, as a matter of fact, a complex impact on economic information through computer and other technology, in practice lead the economies of individual countries and the world as a whole to a new level, providing a sustainable positive result. There is a different type of industrial production, rural and urban economy, based on the possibilities of "big data" and proper analytics, total automation of production, technologies of augmented reality, etc.

There is a different type of industrial production, rural and urban economy, based on the possibilities of "large data" and proper analytics, total automation of production, technologies of augmented reality, etc. A definite impetus to the actualization of the discussion of the formation of the single digital space of the EAEU was given by the challenges of the current time, such as the freedom to choose the jurisdiction of consumption, the creation of value added by economic entities of the Union in the jurisdictions of third countries, the depreciation of traditional assets, depletion of competence and talent drain. Information innovations will allow Eurasian integration partners not only to occupy their niche in the global digital space, but also to determine common priorities and create an environment that will enable national enterprises to generate added value in global digital cooperation, be active participants in new digital markets and become strategic co-owners of digital assets.

In this context, the optimal use of digitalization and IT, according to the member of the EEC Collegium (Minister), K. Minosyan, can become "a key to deepening the Eurasian integration processes and removing barriers and restrictions, modernization and cooperation", "give new impetus to the Eurasian integration project and unite the efforts of Member States towards the digital transformation of economies" [3].

This sphere becomes the priority direction of the economic strategy, which was reflected in the program for the long-term development of the EAEU until 2030 [4]. The growth of the "integration connective tissue" through the intensive introduction of IT into the economy of the EAEU will help resolve a number of problems: the activation of cross-border interaction of state bodies, business entities and individuals; the increase of national economic security and the achievement of a sustainable economic growth; the strengthening of mutual trade with the use of electronic commerce mechanisms; the improvement of the investment climate; the introduction of monitoring of the process of scientific and industrial cooperation, general programs and projects of industrial and innovative development of the EAEU countries; the formation of a system of information exchange between the partners of the association, etc. In modern conditions, the world experience of integration and regional cooperation, in particular, the EU, ASEAN, should be used more actively to strengthen inter-firm relations in the innovation sphere, which becomes the core of regional economic development and where the ratings of the EAEU countries (in 2016, according to the index of economic innovation among 128 states of the world, the countries of the EAEU took positions from 43 (Russia) to 103 (Kyrgyzstan) [4].

Despite some uneven processes in the formation of the software industry and the introduction of new IT in various sectors of national economies, at this stage it is possible to record obvious positive changes in the use of these tools that contribute to deepening the processes of regional economic interaction within the framework of the Eurasian integration project. So, at the initiative of business representatives, since November 2015, work is underway to form a unified digital association space. Significant steps in this direction were the definition and development of common standards for the accelerated coordinated digitization of the EAEU and the creation of a cross-border trust area, participation in the digital market of the EAEU of small and medium-sized enterprises on general competitive conditions, development of common activities for identifying and launching priority areas based on breakthrough initiative projects on the digital transformation of the economy, megaprojects and digital platforms for entering global markets and developing an image of the EAEU with digital opportunities in the long run for 2025-2030.

A multifunctional information portal is under development, which will become an effective mechanism for ensuring the cooperation of integration structures in the information space of the EAEU countries, comprehensive information and analytical support and scientific and technological exchange within the framework of regional economic interaction. An

important condition for the success of the integration process is the openness of the goals and objectives of the association, an understandable and transparent structure, facilitated by the creation and functioning of the official site, legal portal and the site of the EAEU court [5, p. 49].

Approved on December 26, 2016 at a meeting of the Supreme Eurasian Economic Council, the Customs Code of the EAEU is called upon to ensure uniform customs regulation throughout the association through the use of new approaches to informatization with a view to maximizing the unification of customs operations and the introduction of a business-friendly mechanism for interaction with state bodies, cross-border trade issues [6].

Thus, at the present stage of creating the postindustrial information economy, the prospects for the development of the EAEU largely depend on the active implementation and effective use of modern IT, which are an important factor in the intensification of integration processes, the achievement of an optimal economic result and, as a result, the economic competitiveness of the association in the system of regional integration projects on the territory of the Eurasian continent and in the overall system of world economy.

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**Аннотация.** Рассматриваются информационные технологии как фактор интенсификации интеграционных экономических процессов регионального международного образования на постсоветском пространстве – Евразийского экономического союза. Инновационные IT решения оказывают комплексное воздействие на экономическую информацию, способствуя повышению уровня развития национальных экономик стран-партнеров объединения и реализации совместной цели – модернизации и интеграции национальных хозяйств для достижения устойчивого экономического роста, повышения уровня жизни населения и конкурентоспособности на мировом рынке.

**Ключевые слова:** Евразийский экономический союз, современные информационные технологии, интеграционные процессы, экономика, устойчивое развитие.

**Summary.** Information technologies are considered as a factor of intensification of integration economic processes of regional international education in the post-Soviet space – the Eurasian Economic Union. Innovative IT solutions have a complex impact on economic information, contributing to the improvement of the national economies of the partner countries and the joint goal of modernizing and integrating national economies in order to achieve sustainable economic growth, improve living standards and competitiveness on the world market.

**Keywords:** Eurasian Economic Union, modern information technologies, integration processes, economics, sustainable development.

UDC 339.13

#### **4 FACTORS THAT SHAPE MARKET TRENDS**

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#### ***Introduction***

Trends are what allow traders and investors to capture profits. Whether on a short- or long-term time frame, in an overall trending market or a

ranging environment, the flow from one price to another is what creates profits and losses. There are four major factors that cause both long-term trends and short-term fluctuations. These factors are governments, international transactions, speculation and expectation, and supply and demand.

#### **Major Market Forces**

Learning how these major factors shape trends over the long term can provide insight into why certain trends are developing, why a trend is in place and how future trends may occur. Here are the four major factors:

#### **1. Governments**

Governments hold much sway over the free markets. Fiscal and monetary policy have a profound effect on the financial marketplace. By increasing and decreasing interest rates the government and Federal Reserve can effectively slow or attempt to speed up growth within the country. This is called monetary policy.

If government spending increases or contracts, this is known as fiscal policy, and can be used to help ease unemployment and/or stabilize prices. By altering interest rates and the amount of dollars available on the open market, governments can change how much investment flows into and out of the country.

#### **2. International Transactions**

The flow of funds between countries impacts the strength of a country's economy and its currency. The more money that is leaving a country, the weaker the country's economy and currency. Countries that predominantly export, whether physical goods or services, are continually bringing money into their countries. This money can then be reinvested and can stimulate the financial markets within those countries.

#### **3. Speculation and Expectation**

Speculation and expectation are integral parts of the financial system. Where consumers, investors and politicians believe the economy will go in the future impacts how we act today. Expectation of future action is dependent on current acts and shapes both current and future trends. Sentiment indicators are commonly used to gauge how certain groups are feeling about the current economy. Analysis of these indicators as well as other forms of fundamental and technical analysis can create a bias or expectation of future price rates and trend direction.

#### **4. Supply and Demand**

The term "demand" in economics means a solvent demand there is a need that a subject is able to pay. From this definition it follows that the demand for a particular product (service) depends on the price. The relationship between price and demand is constant. The reason for changing

demand is price change. This inverse causal relationship between the price of a good and the amount of demand is the law of demand. The law of demand is realized through the economic behavior of the consumer. Why explain that the consumer is willing to buy more goods at a lower price. First, consumer income is always limited. objectively, for a lesser price, he can buy more goods. Secondly, the law of decreasing marginal utility operates in the economy. The point is that each next unit of the product brings less satisfaction than the previous one, so the consumer is ready to purchase every next unit of the product for a lower price. Supply is the quantity of a good that sellers wish to sell at each price. Other things equal, when prices are high, the supplied quantity is high as well. The market is in equilibrium when the price regulates the quantity supplied by producers and the quantity demanded by consumers. When prices are not so high as the equilibrium price, there is excess demand (shortage) raising the price. At prices above the equilibrium price, there is excess supply (surplus) reducing the price. There are some factors influencing demand for a good, such as the prices of other goods, consumer incomes and some others. An increase in the price of a substitute good (or a decrease in the price of a complement good) will at the same time raise the demanded quantity. As consumer income is increased, demand for a normal good will also increase but demand for an inferior good will decrease. A normal good is a good for which demand increases when incomes rise. An inferior good is a good for which demand falls when incomes rise. As to supply, some factors are assumed as constant. Among them are technology, the input price, as well as degree of government regulation. An improvement in technology is as important for increasing the supplied quantity of a good as a reduction in input prices. Government regulates demand and supply, imposing ceiling prices (maximum prices) and floor prices (minimum prices) and adding its own demand to the demand of the private sector.

#### Effect on Short- and Long-Term Trends

With these factors causing both short- and long-term fluctuations in the market, it is important to understand how all these elements come together to create trends. While these major factors are categorically different, they are closely linked to one another. Government mandates impact international transactions, which play a role in speculation, and supply and demand plays a role in each of these other factors.

Government news releases, such as proposed changes in spending or tax policy, as well as Federal Reserve decisions to change or maintain interest rates can have a dramatic effect on long term trends. Lower interest rates and taxes encourage spending and economic growth. This has a tendency to push market prices higher, but the market does not always



respond in this way because other factors are also at play. Higher interest rates and taxes, for example, deter spending and result in contraction or a long-term fall in market prices.

In the short term, these news releases can cause large price swings as traders and investors buy and sell in response to the information. Increased action around these announcements can create short-term trends, while longer term trends develop as investors fully grasp and absorb what the impact of the information means for the markets.

#### The International Effect

International transactions, balance of payments between countries and economic strength are harder to gauge on a daily basis, but they play a major role in longer-term trends in many markets. The currency markets are a gauge of how well one country's currency and economy is doing relative to others. A high demand for a currency means that currency will rise relative to other currencies.

The value of a country's currency also plays a role in how other markets will do within that country. If a country's currency is weak, this will deter investment into that country, as potential profits will be eroded by the weak currency.

#### The Participant Effect

The analysis and resultant positions taken by traders and investors based on the information they receive about government policy and international transactions create speculation as to where prices will move. When enough people agree on direction, the market enters into a trend that could sustain itself for many years.

Trends are also perpetuated by market participants who were wrong in their analysis; being forced to exit their losing trades pushes prices further in the current direction. As more investors climb aboard to profit from a trend, the market becomes saturated and the trend reverses, at least temporarily.

#### The S & D Effect

This is where supply and demand enters the picture. Supply and demand affects individuals, companies and the financial markets as a whole. In some markets, such as the commodity markets, supply is determined by a physical product. Supply and demand for oil is constantly changing, adjusting the price a market participant is willing to pay for oil today and in the future.

As supply dwindles or demand increases, a long-term rise in oil prices can occur as market participants outbid one another to attain a seemingly finite supply of the commodity. Suppliers want a higher price for what they

have, and a higher demand pushes the price that buyers are willing to pay higher.

All markets have a similar dynamic. Stocks fluctuate on a short and long-term scale, creating trends. The threat of supply drying up at current prices forces buyers to buy at higher and higher prices, creating large price increases. If a large group of sellers were to enter the market, this would increase the supply of stock available and would likely push prices lower. This occurs on all time frames.

### ***Conclusion***

Trends are generally created by four major factors: governments, international transactions, speculation/expectation, and supply and demand. These areas are all linked as expected future conditions shape current decisions and those current decisions shape current trends. Government affects trends mainly through monetary and fiscal policy. These policies affect international transactions which in turn affect economic strength. Speculation and expectation drive prices based on what future prices might be. Finally, changes in supply and demand create trends as market participants fight for the best price.

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**Аннотация.** Тенденции – это то, что позволяет трейдерам и инвесторам “ухватывать” прибыли. В краткосрочных или долгосрочных временных рамках, на всем рынке или его части, именно движение от одной цены к другой создает прибыли и убытки. Описаны четыре главных фактора, служащих причинами долгосрочных тенденций и краткосрочных колебаний. Эти сферы связаны, так как ожидаемые будущие условия формируют текущие решения, и эти текущие решения формируют текущие тенденции. Государство влияет на тенденции, главным образом, посредством кредитно-денежной и фискальной политики. Эта политика влияет на международные платежные операции, которые, в свою очередь, влияют на экономическую силу страны. Предположения и ожидания управляют ценами на основе предположений и ожиданий о возможных ценах в будущем. В заключении отмечено, что, изменения в

предложении и спросе создают тенденции, так как участники рынка борются за лучшую цену.

**Ключевые слова:** тенденции, рыночные факторы, государство, спрос и предложение, предположения и ожидания.

**Summary.** Trends are what allow traders and investors to capture profits. Whether on a short- or long-term time frame, in an overall trending market or a ranging environment, the flow from one price to another is what creates profits and losses. There are four major factors that cause both long-term trends and short-term fluctuations. These factors are governments, international transactions, speculation and expectation, and supply and demand. These areas are all linked as expected future conditions shape current decisions and those current decisions shape current trends. Government affects trends mainly through monetary and fiscal policy. These policies affect international transactions which in turn affect economic strength. Speculation and expectation drive prices based on what future prices might be. Changes in supply and demand create trends as market participants fight for the best price.

**Keywords:** trends, market forces, governments, supply and demand, speculation, expectation.

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## **SIGNIFICANCE AND SHORTCOMINGS OF ACCOUNTS PLAN IN ACCOUNTING INFORMATION SYSTEM**

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A basic tool in an accounting system which allows to organize and make understandable all facts of current activity is accounts of accounting. Account plan is the base for forming accounting information system. Permanent accounts and subaccounts digital codes are used instead of naming operations which eases accountant's duties. Also accounts plan contributes to building accurate reporting. Correct selection of synthetic accounts and their optimal content is an important part.

The main goal of developing accounts plan is accessible reflection of economic processes in a company otherwise there is no base to reflect adequate identical economic operations and possibility to control forming of

reliable indicators of organizations.

There is one single accounts plan in Russia built according to the “economic resources cycle” model. This accounts plan contains eight sections of systems and accounting as well as “off-balance accounts” which is section nine. Such an accounts plan is adapted for problems of estate management, allows to keep its separate accounting, and not connected with financial reports frame which ties down accountants to convert these accounts into another type which is based on reflection of reporting elements.

Each organization makes a unique accounts plan which consists of synthetic and analytic accounts list which is required for activities and keeping reporting of an organization. Its own plan is an important element of organization’s accounting politics. Along with organization development its operating accounts plan gradually expands because of new subaccounts.

Financial reporting has to reflect adequate information otherwise it becomes ineffective. There are fundamental problems of financial reporting: low level of information transparency, incomplete reflection of all facts concerning economic life. Due to incorrect information of financial situation in the companies Russia lacks investment inflow. Forming reporting according to the international standards is one of the conditions which makes possible domestic companies get acquainted with the international capitalistic market. Financial reporting formed according to the international standards is quite different from the one formed according to the Russian standards. Practicing IFRS (*International Financial Reporting Standards*) provides reduction of resources and time spent to make new subjects of keeping financial reporting.

Therefore, we can say that accounting information accounts plan in Russia is one of the main features of an accountant but it requires constant modernization and revision such as:

It is necessary to boost the quality of information formed in financial reporting;

Make it possible for the organizations to keep reporting according to the international standards. Legislation only designates international standards as the base for comprising federal accounting standards;

It is essential to take into consideration economic aspects of Russia and to give the juridical force to IFRS.

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**Аннотация.** В статье исследуется значение плана счетов в прозрачности отражения фактов экономической жизни, а также определяются недостатки текущего плана счетов в России.

**Ключевые слова:** бухгалтерский план, бухгалтерский учет.

**Summary:** In present article significance of accounts plan in transparency of economic life facts reflection is studied as well as shortcomings in current Russian account plan are determined.

**Keywords:** accounts plan, accounting.

UDC 338.3

## ILLEGAL OPERATION WITH CASH

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Money in modern realities represents all the same functions, as many centuries ago: it is a mean of payment for some goods, is being sold, exchanged or gifted. In addition to cash settlements, non-cash funds are also widely used. This is due to the easy way of their using. However, in the

21st century, with the growth of the market, there is a shadow economy with its illegal money circulation, or "money laundering", and unreasonable tax benefits, called cashing.

So, like many financial crimes, cashing out money for tax evasion threatens with severe criminal liability, which is described in articles 198 of the Criminal Code of the Russian Federation and 199 of the Criminal Code of the Russian Federation.

At the first side this operation seems quite legal. The director has the authority to sign payment documents to withdraw money from the account, but it should have legal explanation. This operation pursues the goal not to withdraw money from the account, but to increase the expenses of the organization. In this case, there is an intermediary, a one-day company, to which receives a smaller percentage for mediation in the scam than the amount of taxes that the owner is obliged to pay to the state, which is why such transactions are called unreasonable tax benefits.

The goal of turning non-cash money into cash is the withdrawal of funds from circulation. Outline which uses the bank deposit is simple - to place free finances in the deposit can both physical and legal person, both in cash and by cashless way. Third faces have the right to make transfers to the depositor's account. The delivery of funds is made at the first request of the client. All of the above is based on the provisions of Chapter 44 of the Civil Code "Bank Deposit". A financial entity opens a long-term deposit with a credit institution and places a small amount on it. The intermediary makes a transfer to the client of the bank by a non-cash way, and after that the money is withdrawn and transferred to the representatives of the fictitious company. At the same time, banks do not charge fees for early closure of accounts and termination of the contract .

To prove the illegality of such an operation is almost impossible. The investor will be able to substantiate the reason for closing his account by urgent payments or debts, and the presence of a fictitious organization is not grounds for accusing the client of the bank. However, with all the shortcomings of the legislation, such a scheme is easy to notice. Early termination of the deposit contract on demand, transfer of funds to the account by cashless transfer and a large amount of payment are characteristic signs of an illegal operation.

If earlier for the Federal Tax Service primary documentation was sufficient, now all the data must correspond to the real capabilities of the company. An important factor is the confirmation of the good faith of the counterparty. If the counterparty was created shortly before the companies entered into a transaction, they receive revenue only from the company, then the tax authorities will consider it as doubtful.

Not justified tax benefit shouldn't be confused with the legalization of money (st.174 Criminal Code). In this case, the transaction occurs in reverse order and allows you to transfer funds received in the results of illegal activities to other assets. This is necessary to ensure that their passage remains unknown. It can be bribes, theft, extortion and so on.

Legalization takes place in several stages. On the first money is placed in monetary institutions, then financial transactions are conducted to hide the fact that the money was received illegally. At the end, the funds are returned to the offender, but already "clean".

Over the past 20 years, the problem of legalizing illegal incomes has become a major issue not only in Russia, but also in the international community. It promotes corruption and undermines financial institutions. In some developing countries, illegal revenues may exceed state budgets. Such operations can adversely affect currencies and interest rates, as money is reinvested in those industries where it is less likely to disclose such schemes, and not where their returns are higher. They also reduce the tax revenues of the state, which can lead to an increase in tax rates.

The main method of combating shadow money turnover in Russia, first of all, is the current legislation, and further tightening it can contribute to a decrease in illicit trafficking. From the point of view of the bank, it is necessary to introduce a constant monitoring of cash receipts to the account of the organization, since the speed of obtaining money is the main factor of the shadow economy. It is also necessary to use tariffs and limits for cash withdrawal in ATMs and immediately respond to questionable amounts.

According to the Bank of Russia, in at 2016, questionable operations amount from 80 before 92 billion rubles. About 48 before 60 billion rubles falls on shadow turnover of cash on sector of travel agencies. According to the scheme with participation of transport service providers in year was withdrawn 25 billion rubles, through fictitious transactions on purchase and sale of software and rights to intellectual property - over 7 billion rubles.

As the statistics show, most often such operations are carried out in the Central Federal District and in Moscow. For the year 2016 - more than 92 627 times the amount of more than 356 566 thousand rubles. As for Sevastopol, in 2016, 22 such operations were observed, amounting to 52.3 thousand rubles.

In Russia, the number of unauthorized transactions with funds are constantly increasing. In 2016 the share of illegal transactions in the total volume of operations was 0.0021%, a third is in Moscow.

The Russian Federation has entered the top five countries with the largest shadow economy. Its volume is 33.6 trillion. or 39% of the country's GDP. The indicator of the shadow economy in Russia is one of the highest,

it is 84% higher than the world average. A larger volume only in Ukraine, Nigeria and Azerbaijan. The lowest indicators of the shadow sector for 2017 are recorded in Japan and China. In the world GDP, the share of the shadow economy was 22.7%. In Russia, this indicator does not change: in 2012 it was 39.33%, and by 2025 39.3% is expected.

ACCA defines the shadow economy as an activity "deliberately hiding from state structures". According to the head of the department Alexander Surinov, there are sectors where almost 50% of the economy is not observed for example, agriculture, real estate operations and construction.

In order to minimize the risks of fraudulent transactions with funds, the Bank of Russia is improving the legislation and regulations in the field of information security of financial organizations, developing new standards. Banks create internal control systems that are likely to be unable to eradicate illegal transactions, but will allow banks to operate safely.

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**Аннотация.** Деньги в современных реалиях выступают средством платежа за определенные блага, продаются, обмениваются или



дарятся. Кроме наличных расчетов широко используются и безналичные. В 21 веке с развитием рынка имеет место и теневая экономика – незаконный денежный оборот, или «отмывание» денег, и необоснованная налоговая выгода, называемая обналичиванием. По данным Банка России, в 2016 году прошло сомнительных операций на сумму от 80 млрд. до 92 млрд. руб. В статье описаны особенности таких операций и современные методы борьбы с ними.

**Ключевые слова:** Деньги, наличность, незаконные операции, необоснованная налоговая выгода, легализация доходов

**Summary.** Money in today's realities are a means of payment for certain benefits, are sold, exchanged or given. In addition to cash payments, non-cash payments are also widely used. In the 21st century with the development of the market takes place the shadow economy – illegal money turnover, or "laundering" of money, and unjustified tax benefit, called cashing. According to the Bank of Russia, in 2016 passed questionable operations about 80 billion to 92 billion rubles. The article describes the features of such operations and modern methods of dealing with them.

**Keywords:** Money, cash, illegal operations, unjustified tax benefit, legalization of income

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## INVESTMENT FINANCIAL LITERACY

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A small investment creates the biggest state.

In recent years, more and more is said about the financial literacy of the population. All our lives we are taught how to make money, how to work more. That is why 98% of the World's population is financially illiterate. Educational institutions produce specialists in the field of Finance, but almost no one knows how to properly and very affordable to save and multiply the money already earned.

Low levels of financial literacy and lack of understanding in the area of personal Finance can lead not only to bankruptcy, but also to illiterate retirement planning, vulnerability to financial fraud, excessive debt and social problems, including depression and other personal problems.

Statement of the Vice-President of the Council for financial literacy under the President of the United States John Bryant is very well demonstrated by the importance of financial literacy for individuals and society: "Financial culture in the modern developed and rapidly changing world has become another vital element in the skill system and rules of conduct. Financial literacy will allow a person not to depend on the circumstances, on the will of other people, the system. An educated person himself will choose the ways in life that will be most attractive to him, creating a material basis for the further development of society."

Financial independence is the capital with which a person fully covers their monthly expenses, and can live 10 years without working. At the same time, his standard of living will not deteriorate.

Example 1: your monthly expenses are \$1,000. Multiply by 12 months and then 10 years, get 120'000 \$. Thus, this amount will be enough for you to live without working 10 years, and maintain the same standard of living.

Financial freedom is an income from capital, with which a person fully covers his / her monthly expenses and at the same time his / her capital at least does not decrease.

Example 2: when you invest the same \$ 120'000 at 10% per annum, you get \$ 12'000 per annum, i.e. you need \$ 1'000 per month.

Many seek financial independence, and think that if they start to earn more-they will become richer. However, a person makes rich not the amount of money earned, but the amount of assets. But in order to become a financially independent person — you must first determine what financial flow you are in, and understand what flow you need to strive.

There are three types of financial flows:

1. Financial flow of the poor
2. Financial flows of the middle class
3. Financial flows of rich people

Financial Flows To The Poor Class

How to make money for a month or so and spent

Earned \$200 - \$ 200 spent

Earned \$1 ' 000- \$ 1'000 spent

Earned \$10 ' 000- \$ 10'000 spent

Earned \$50 ' 000- \$ 50'000 spent

Saved nothing — nothing left

People living on this principle always say that they do not have enough money for anything. This is natural — the more people earn, the more spending

Financial Flows Of The Middle Class

Usually, these are people who have a highly paid job, social security

from the employer. They are able to pay loans for a car, an apartment, etc.

Financial flows move in the following way

The middle class buying on credit car, apartment, etc. think that they acquire Assets. But, in fact, they acquire obligations, and once they are left without work, and the recent example of 2008, when vast numbers of people have been left without means of subsistence - such people are moving into poverty.

Financial Flow Of The Rich Class

The more Assets, the more income, the more income – the more Assets. A closed cycle is like a natural cycle in nature. So why are the poor poor, and the middle class always struggling with credit? Because the poor and middle classes work for money, and the rich work for assets. Wealth is not the presence of things and money, and it is not connections. Just as poverty is Not a lack of money and of some plural things and connections.

An investment is an investment anywhere. There are different ways and sectors where investments are placed: deposit in bank; be a co-owner of small and medium-sized businesses; insurance company; investment fund; stock; futures; options; stock; currency; stock Exchanges, Commodity Exchanges; Forex Currency Exchange; realty; HYIP Program; antiques; art; precious metals: Silver, Gold, Platinum; gemstones: Sapphires, Rubies, Diamonds and Diamonds; trust management; training. Investing is an understanding of how your money can grow from year to year and at the same time give high interest on deposits.

Example 1. If every day you save \$ 1, per month save up 30\$ for a year of 360\$. Of course, this is not entirely accurate, because in the year 365 days, but for ease of calculation we will operate rounded numbers. So, in 10 years is 3'600\$. For 30 years, run across a total of 10'800\$ . If, starting from the second month, to invest this money at 12% per annum, then with the capitalization.

After 10 years, the amount will be 6'901 \$

Of these invested funds 3 ' 600 \$

And the amount of complex interest will be 3 ' 301 \$

i.e. almost the same amount as was invested

After 20 years, the total amount will be 29 ' 677 \$

Of these invested 7 ' 200 \$

And the amount of compound interest 22 ' 477 \$

that is, 3 times more than the amount of investment

After 30 years, the total amount will be 105'097 \$

From them the investment of 10'800 \$

And the amount of compound interest 95 ' 097 \$

I. e. almost 9.5 times more

Example 2. Suppose you invest 10,000 \$ . After 20 years, taking into account monthly capitalisation, i.e. the interest on the interest may be the following result: at 12% 110'014 \$ (1000% in 20 years 50% per annum) at 15% per annum 199'619 \$ (1890% in 20 years, 94,8% per annum), with 18% APR 361'673 \$ (3560% in 20 years, 178% per annum) with 24% annual 1'182'065 \$ (11 120% for 20 years, 556% p = 46% per month) at 30% per annum 3'841'064 \$ (38 310% for the 20 years 1915% p = 159% per month).

According to statistical surveys of the population, one third saves money for an apartment; 22% save money just in case, many save up for a car, someone for education and other needs. It is important to highlight the word "hoarding", that is, simply money, in the best case, in a Bank Deposit, in the worst case in my Desk drawer. Only 2% invest in their own business, and another 2% in securities.

Thus, only four percent of the population has money "working", and only a negligible percentage decides to deal with the stock market. The low involvement of the population in the circulation of securities is a real problem that hinders the development of the stock market, and therefore hinders the entire economy. Moreover, the low level of investment literacy poses another danger: the vulnerability of people. The one who is not versed in financial instruments, to a greater extent inclined to believe the fraudsters, promising another way to "get rich quick". Only the study of financial and investment literacy will help humanity to raise the world economy and increase the standard of living.

**Аннотация:** Данная работа способствует просвещению населения в области финансовой и инвестиционной грамотности. Ключевая цель - повышение финансовой грамотности граждан, содействие формированию у населения разумного финансового поведения, обоснованных решений, ответственного отношения к личным финансам, повышение эффективности защиты их интересов как потребителей финансовых услуг.

**Ключевые слова:** финансовая свобода, финансовая независимость, инвестиции, финансовый план, капитализация.

**Summary:** This work contributes to the education of the population in the field of financial and investment literacy. The key goal is to increase the financial literacy of citizens, promote the formation of the population's sound financial behavior, informed decisions, responsible attitude to personal Finance, improve the protection of their interests as consumers of financial services.

**Key words:** financial freedom, financial independence, investments, financial plan, capitalization

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## **CRYPTOCURRENCY IS THE CURRENCY OF THE FUTURE**

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Everybody must have heard about cryptocurrencies today, but not everyone fully understands what they mean and how they are used.

The term "cryptocurrency" has emerged in everyday life after publication in the magazine Forbes in 2011, which mentioned the name "crypto currency". So the given article is going to clarify what "crypto currency" is? In other words, it is a digital or electronic currency, which is produced on the Internet and stored there on virtual wallets [1]. Physically, it cannot be touched, because it is simply absent. When creating this currency, a special cryptographic cipher is used, consisting of sequential hashing and digital signature, which works on the basis of blockchain.

Hence the first part of the word – crypto. At first glance, cryptocurrency is similar to traditional electronic payment systems. However, in fact, the differences between them are enormous. And the first is the method of issuing and storing money.

To understand the advantages of cryptocurrency, you need to understand what is blockchain technology. Blockchain technology removes intermediaries and allows users to send data directly to each other. To develop, you need to invent constantly something new. And that's about digital money.

Some already call the blockchain a breakthrough of the 21st century, the greatest invention comparable to the discovery of the Internet, others are still looking with caution at it.

We cannot but mention the Ledger or "block chain". In other words, it is a database that is stored on multiple computers simultaneously. New blocks in this chain base are being constantly created. Each newly created block contains a group of recently accumulated and ordered records

(transactions), as well as a header. When a block is formed, it is checked by other members of the network and then, if all agree, is connected to the end of the chain. Once this has happened, it is no longer possible to make changes to it. In addition to the new information block is also stored in encrypted form and information about previous blocks. And the database is automatically updated on all computers connected to the system. Let's enumerate the basic principles of the blockchain:

- decentralization and distribution;
- safety and security;
- openness and transparency;
- immutability already recorded.

Any significant information relating to a particular sphere of people's lives is stored somewhere. Buying a house or a car, taking a loan, marriage registration, money transfers – all data on these operations are recorded and placed centrally on the servers of state institutions or private companies. This often leads to abuse – if desired, you can climb into any database and make adjustments. The blockchain technology fundamentally changes this approach. Its essence lies in the fact that the data are not stored in one place, and are distributed over thousands, if not tens of thousands, and sometimes millions of computers scattered around the world. The probability that all of them will be disabled, is negligible and looks fantastic. For now at least one computer of a network works, the system based on a blockchain exists. As it has been already mentioned, any centralized database can be hacked and modified. It is almost impossible to do this with blockchain. Hack one of the blocks and change the information in it makes no sense, because you have to break all the blocks, as well as copies of the database on all computers, and this requires huge computing power. In addition, a powerful encryption algorithm using hash functions, as well as digital signature, will become an obstacle to falsifications [2].

The signature uses two types: keys-public and private. The first one is required to verify the signature itself, the second is used when it is created and is secret. Keys provide participants with access to information.

We cannot help admitting that we have to deal with intermediaries all the time. There are cases when money may not reach the addressee because the Bank, through which we made a translation, might not like transaction and he will stumble upon it. This may result in the refusal of the transfer or a long delay in time. Therefore, although we do not fully trust all sorts of intermediaries, they are forced to use their services at risk, because there is no other alternative. Thanks to blockchain, interaction without intermediaries becomes a reality. This technology allows direct data exchange.

The authenticity of the transaction in the system of checks directly to its members. The network is formed by users who are interested in using this or that type of information. Participants are divided into two types: simple users; block builders or, as they are called, miners. Standard users create new transaction records on the network. For example, "to transfer the payment user X 100 conventional units". And miners from these records already form blocks. Records are confirmed and entered in the block only if it accords to the majority. The others are ignored and are not considered valid until they are in the content of one of the following blocks. Only the owner of the key that opens access to the record can use this or that record. To become a miner, it is enough to allocate the power of your computer to produce new blocks. The network is connected using special software. Different types of services and applications are built on blockchain technology. There are public supranational systems, which anyone can join and become a simple user or miner. The community itself administers the Association. There are also private or so-called exclusive blockchain networks and services that are supported and controlled by their creators. To become a participant, you need to fulfill certain conditions set by the organizers.

Mine new blocks in such systems can be clearly established by certified circle of persons. The blockchain platform is a distributed database for public use, where there is mostly no centralized control over the process [2].

We all know that using blockchain, it is easy to keep records, store data, and make transactions in any sphere of life: financial transactions; real estate transactions; insurance; logistics; traffic violations; marriage registration and much more. This technology is promising, because it can be widely used.

Today, the United States are actively considering ways to introduce blockchain into the voting system. China wants to transfer the work of the National social insurance Fund to the blockchain. This technology will be closely interwoven in the system of "smart cities", which actively embody in reality in China. On the basis of blockchain startups in the field of medicine, protection of intellectual property and copyright are already being created. The technology is used to develop identification systems, web browsers, decentralized cloud storage, as well as social networks. Moreover, it has been created a whole virtual nation – BITNATION, which opens embassies in different countries. To become a citizen. More and more on hearing so-called smart contracts, or in other words smart contracts which work at blockchain and considerably simplify procedure of signing of contracts. In this case, there is no need to involve a third party in the

process, which would act as a guarantor of compliance. Here, the program code automatically decides what to do with an asset and confirms that the conditions are met. All stakeholders of the process at any time may conduct an audit of the transaction. As for an international trade the technology was first tested in early autumn 2016. Then on the platform to Wave the British Bank Barclays it was held a letter of credit for 100 thousand dollars, providing the export company from Ireland Ornuia a large batch of dairy products to the address in Seychelles of the company. As a standard, this transaction takes at least a week, it took about four hours [2].

Blockchain is a universal technology applicable in different spheres of life, which is its unique advantage. In addition to those already addressed above of openness, safety and security, the blockchain also reduces transaction costs. Reduces the time of transactions from a few days or even weeks required for data verification and document exchange to several hours. It allows organizations and institutions to get rid of unnecessary expenses. Today, the blockchain is not able to provide a huge number of transactions in a short time. For example, MasterCard or Visa payment systems process about 45 thousand transactions per second, while bitcoin has only 7 thousand transactions. Also do not forget about the load on the electrical network. All these complex calculations make computers consume a lot of energy. Speaking of the invulnerability of the blockchain, experts also point to the probability of the so-called "51% attack". In other words, if a group of network participants concentrates 51% of computing power in their hands, they can start acting in their own interests, confirming only profitable transactions. However, this will require resources that are so powerful that it is extremely difficult to put this idea into practice. Blockchain in Ukraine and in the Russian Federation, the technology is going to officially legalize and begin to implement in 2019, by adopting the necessary regulations. While major banks of the country jointly with the Central Bank with the aim of increasing the efficiency of the financial system created a platform "Mastercam". An interesting project on the block chain operating in Moscow. The platform is called "Active citizen", and with its help conduct all sorts of voting related to the improvement of life in the capital. In Ukraine, today the blockchain partially transferred the State land cadastre. In particular, the process of checking the statement works on this technology. At the second and third stage of inventory blockchain, the existing database will be transferred to the distributed registry, and then all transactions will be hashed. The next step is also the State register of property rights to real estate [2].



The first application of blockchain in practice took place in 2009, when bitcoin was created on its basis. Later, such cryptocurrencies have appeared in a great amount of forms for very different taste.

So let's now consider what is "Bitcoin"? Bitcoin can be called the ancestor of all cryptocurrencies. Its short designation is "BTC". Blockchain technology lies at the heart of bitcoin.

Bitcoin is virtual money that exists only on the Internet. And the price depends solely on the existing demand. It is mined, like all other cryptocurrencies, by mining using complex mathematical calculations. Millions of computers around the world are constantly working on this process, both ordinary Internet users and those who create a serious business by collecting mining farms [3].

And as a result, we get a continuous chain of blocks, each of which stores the latest data on mutual settlements between users. The most important features of the virtual currency bitcoin are: anonymity; the transparency of the transaction; lack of control on the part of regulators; there is no owner who sets his own rules; fraud protection-transactions performed can no longer be changed.

Let's clarify each of these features. The anonymity of bitcoin is based on the fact that when creating a wallet and transferring money you do not need to specify your personal data. Even the recipient of bitcoins may not know the name of their sender.

Bitcoin does not belong to any state and is not controlled by anyone. It is a decentralized system, the data of which is stored on the computers of the users themselves. And the network user from one corner of the planet can easily send any number of bitcoins to another user no matter where he is. Most importantly, everyone should have access to the Internet and bitcoin wallet [3].

Many people equate bitcoin not to a currency, but to goods such as oil or gold. After all, it is extracted from the depths, albeit not real, terrestrial, and virtual. Previously, bitcoins were mined by everyone. It was enough to install the program on your computer and start mining new coins. Mainly processors and, later, graphics cards. Then connected to the case ASIC-Board (Application-specific integrated circuit), the main purpose of which is to calculate the hash function Sha-256 algorithm, underlying bitcoin. Over time, the level of complexity of calculations has increased many times and today bitcoin is mined by professionals who have huge computing power. How many bitcoins will be issued has been determined in advance. Once the figure reaches 21 million, the currency issue will be stopped. And that is why bitcoin is not afraid of inflation. You can't stamp it in unimaginable quantities to be devalued afterwards.

Both the positive side and the disadvantage of bitcoin is anonymity in monetary matters. Thanks to the anonymity of the easy getting of money laundering and various fraud via bitcoin. Hackers often demand ransom from their victims in bitcoins. Also, unlike Western countries in the post-Soviet space, bitcoin has not yet received mass distribution. The advantages of bitcoin cryptocurrency should include the fact that it is digital money, which means you do not need to cut down forests for the arbitrariness of the paper, which will go to the point of baking physical money. The big advantage of cryptocurrencies is speed. If you need to send money, and the sender lives on the other side of the planet or in other country, in this case, we can use a Bank where the transfer takes more than a day. When paying everything in cryptocurrency for the transfer of money it takes no more than six hours, and in some cases, no more than 15 minutes.

A good example of the usefulness of the blockchain system is its introduction into the automotive industry, happening nowadays. Some projects are now developing a blockchain-based system that will be implemented into smart machines. The system will exchange information with nearby machines by transferring transactions where drivers can decide whether to skip the outrunning machine and get a small reward in the cryptocurrency project, or pay to be ceded. The blockchain system, on which the crypto currency works, has already been recognized by all countries of the world as very important and necessary, as well as very promising. Blockchain technology is already being trained at universities. Draft laws are being adopted to introduce cryptocurrency and regulate it in real life.

Today on the Internet for bitcoin you can buy anything. As mentioned above, international shops actively accept BTC for payment. Virtual coins are not disdained even by such giants as Microsoft, Valve, Dell. Bitcoins can also be paid: in restaurants and hotels; for mobile communication and the Internet; when buying tickets; for utilities in some regions; when renting a car and much more. In cities, more and more terminals are installed receiving and issuing cryptocurrency [3].

What are the advantages and disadvantages of the cryptocurrency? Let's start with the advantages of cryptocurrencies: decentralization; direct exchange in the absence of intermediaries; transparency; anonymity; a small fee for transfers, if not their absence; not afraid of inflation; ease of use.

By the way, it is worth noting that in some cryptocurrencies all tokens are issued at the start of the system, and are not extracted gradually over time. These include, for example, Ripple, Cardano, Stellar and others.

And by classic mining coins are mined in these currencies: Bitcoin; Ethereum; Litecoin; Monero; Dash [1].

Cryptocurrency can be acquired in several ways. In addition to the above-mentioned mining, when miners receive a Commission for the generation of electronic currencies, you can get hold of coins either taking them as payment for goods or services, or for cash on specialized cryptocurrency exchanges. Among the popular ones are: Bitfinex; Bithumb; Kraken; Bittrex; Exmo; Poloniex.

Cryptocurrency is stored not in paper wallets, as it is done with physical money, but in special cryptocurrency wallets. They come in many different types: in the form of a program to be installed on your computer – in this case, your coins are stored on your hard drive, as an application for mobile devices. Online wallets, which can be accessed through the browser.

If there are advantages, there may be some disadvantages. In the case of electronic cash, it is important to consider carefully the safety of the wallet, as well as the password to it. If access is lost, you can say goodbye to the money forever. To recover it is almost impossible. It is also worth considering the irreversibility of transactions. If you mistakenly transferred money to the wrong wallet, you will be able to return it only with the voluntary consent of its owner. Among the disadvantages, it is also worth mentioning the ambiguous attitude of different States to the existence of cryptocurrencies. Some countries as Japan regard them as a means of payment, others – as limiting means of their circulation or they completely prohibit any work with it.

Most often, new cryptocurrencies are produced for specific purposes. If bitcoin was developed exclusively for transactions and it is often called virtual gold, so, for example, Ethereum is not only for money transfers, it already includes smart contracts. Also on the basis of its network decentralized applications run. By the way, the role of the silver analog in the world of cryptocurrencies is assigned to Litecoin. Note that digital currencies are not provided with anything: neither gold and foreign exchange reserves, nor the economy of a state. The only thing that determines their value is demand. In January, the Ministry of Finance published a preliminary text of the bill according to which mining will be attributed to entrepreneurial activity, and cryptocurrencies will not be able to be a legal tender [1].

In conclusion, we cannot but say that Cryptocurrency will be the currency of the future. The blockchain system is so promising that it will be used everywhere, which will speed up and simplify the transfer of data and virtual currency. In 1 year, the capitalization of cryptocurrencies exceeded \$ 500 billion. 5 years later, cryptocurrency will be used by all. Prospects of cryptocurrencies and blockchain technologies are sure to be in speed, simplicity and transparency. Blockchain technologies are already being

taught at universities. More and more start-UPS offer (ICO) based on the blockchain. Therefore, more and more people need to understand this, which will lead our lives to new changes and discoveries.

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**Аннотация.** В данной статье рассматриваются перспективы использования криптовалюты в повседневной жизни. Описываются недостатки и положительные стороны использования Биткоина и других криптовалют в будущем. Т.к. о криптовалютах сегодня слышно на каждом шагу, важно понимать, что они означают. Большому кругу людей до сих пор не понятно, как это работает. Для того, чтобы развиваться, нужно постоянно изобретать что-то новое и это коснулось цифровых денег. Если люди поймут перспективы криптовалют, то смогут перейти на новый этап развития. В статье перечисляются способы, как работают криптовалюты, области, где они уже применяются, места, где их можно приобрести.

**Ключевые слова:** криптовалюта, биткоин, альткоины, цифровые деньги, анонимность, блокчейн

**Summary.** This article discusses the prospects of using cryptocurrency in everyday life. The drawbacks and positive aspects of using Bitcoin and other cryptocurrencies in the future are described. Since you can hear about cryptocurrencies almost everywhere, it is important to understand what they mean. A lot of people still do not understand how it works. In order to develop, you need to invent constantly something new and it affected digital money as well. If people understand the prospects of cryptocurrencies, they will be able to move to a new stage of development. The article lists how cryptocurrencies work, where they are already used, where they can be purchased.

**Keywords:** cryptocurrency, bitcoin, altcoins, digital money, anonymity, blockchain.

## **E-MONEY: ADVANTAGES AND DISADVANTAGES**

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Money can be described as a token or a payment option which is used in our society to settle debts and to pay for the services and commodities which are provided to us. In other words, money is the medium of exchange in our society which has also been accepted by the law. Money plays a pivotal role in a country's economy. Without it there is only barter, a relationship between two people each of whom has something which the other wants.

Money provides an intermediary substance, enabling the seller to choose when and where he wishes to become a buyer.

All primitive societies invest certain things with a special value, for example: stones, shells, salt, copper, silver, gold.

### ***Different Types of Money:***

There are several kinds of money varying in liability and strength. The society has modified the money at different times and in this way several types of money are introduced.

There are 4 major types of money: commodity money; fiat money; fiduciary money; commercial bank money

But nowadays the most commonly used type of money is electronic money.

Electronic money is defined as monetary value stored on an electronic device that is accepted as means of payment and used for making payments to undertakings other than the issuer in cash and cashless form.

### ***Advantages of e-money***

1. Simplicity and low cost of emission. Electronic money does not need to be printed, using for this huge production capacity, labour, raw materials, which is associated with large capital costs.

2. Easy to store. The means of electronic payment systems (EPSs) are stored electronically, they do not need packaging, cash storage, transportation, security and other factors required to ensure the circulation of paper money.

3. Independence from banks. Electronic money can not disappear, as a means of bank accounts in the case of bankruptcy of a financial institution.

4. High portability. Electronic money, regardless of the amount, does not have dimensions (volume, weight, etc.), unlike traditional banknotes and coins.

5. Absence of division into nominal values. Due to the electronic nature of the EPSs, there is no problem in selecting the right amount (sum) or change when making payments, etc.

6. No need for recalculation. Electronic money does not need to be counted and recounted; Algorithms of payment systems implement this function, which generally do not make mistakes.

7. No loss of quality over time. Funds on electronic wallets, as they do not have any physical form, do not wear out, do not tear, do not scratch, etc.

8. Convenience of calculations. Electronic money is easy to pay for goods and services on the Internet or send them as private transfers. The transfer operation takes only a few minutes, and the funds arrive almost instantly to the recipient, including transactions between countries.

9. Lack of personification. Electronic money can be transferred without knowing the name, surname, passport data and bank account numbers of the recipient, it is enough to know the number of an electronic wallet.

10. Security system. Electronic payment systems use a variety of modern ways to protect payments and the preservation of funds on electronic wallets. All possible crimes that may be related to the circulation of cash (robbery, theft, etc.) are excluded.

These were the main advantages of electronic money, and now let's look at their shortcomings.

### ***Disadvantages of e-money***

1. Absence of perfect legislative base. In most countries, including the CIS countries there are no effective methods of legal regulation of electronic money. Due to this, electronic payment systems are often used as a means for running shadow business, tax evasion, etc.

2. The need for sufficient level of training as an Internet user. Creation of an electronic wallet, input / output of electronic money, making payments; all this requires a certain level of knowledge. A person who has little or no knowledge of the Internet can make mistakes, and they, in turn, can result in a loss of money.

3. Funds on electronic wallets can be blocked. Many EPSs reserve such an opportunity, with which the user agrees upon signing the offer. In

case of blocking, even if it occurred not through the fault of the user, it is very difficult to return money from the electronic wallet, sometimes it is impossible.

4. The need to store passwords, use a mobile phone. In most cases, for the sake of security of payments, the account of the EPS participant is attached to his mobile phone number, all operations are confirmed through SMS. In addition, it is necessary to remember and store access passwords, sometimes there may be several ones. If you lose your password or mobile phone number, restoring access can be problematic.

5. Personalize data for large payments. To perform operations with electronic money in larger amounts (for example, more than \$ 100) it is necessary to undergo a personalization procedure, i.e., to provide a payment system with a scanned copy of the passport and, if necessary, other documents. Especially when it comes to withdrawing funds.

6. The input / output of funds is quite expensive. To transfer traditional money to electronic money and vice versa, it will be necessary to pay certain commissions: banks, exchange offices, payment terminals and payment systems themselves. The amount of commissions in the aggregate can reach 5% or more, which is quite a lot in comparison, for example, with non-cash settlements in banks or receiving remittances.

7. There is no wide application. Although the turnover of electronic payment systems is steadily growing, electronic money has not yet found widespread use. Not even all online shopping are accepted for payment. That is, it is you can not always pay for the goods or services you need with electronic money.

8. Potential problems with payment systems. Electronic payment systems can experience all sorts of difficulties that will affect all their participants.

9. Possible cases of fraud. In the field of electronic money circulation, there are many fraudsters who try to hack electronic wallet or fraudulently get the owner to transfer money to them. And, it is very difficult or almost impossible to catch such a fraudster.

We have examined the main advantages and disadvantages of electronic money. I hope, you will make the right conclusions, be careful and attentive in using the means of EPS.

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**Аннотация.** В данной статье рассматриваются различные виды денег. Цель данной статьи – изучить электронный деньги, их преимущества и недостатки.

**Ключевые слова:** деньги, виды денег, электронные деньги, преимущества и недостатки электронных денег.

**Abstract.** This article reveals different types of money. The purpose of this article is to examine electronic money, their advantages and disadvantages.

**Keywords:** money, types of money, electronic money, advantages and disadvantages of electronic money.

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## **PROBLEMS OF BUSINESS COMMUNICATION IN THE ACTIVITIES OF THE HEAD**

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Manner, style of communication; communication barriers; channels of communication partner perception.

John Rockefeller owns the words: "the Ability to communicate with people is a commodity... And I'll pay more for that skill than anything else in the world."

The quality of work, emotional mood of employees, stability of personnel, socio-psychological climate in the organization, the presence of conflict situations, the establishment and development of business contacts, affecting the economic situation of the organization as a whole, depends on the art of business communication of the head.

Communication is a form of human activity, leading to the emergence of mental contact, manifested in the exchange of information, mutual influence, mutual respect and mutual understanding.

Business communication includes the whole range of abilities of the head:



<b>have to itself (attraction)</b>	<b>work with information</b>	<b>take into account the individual psychological characteristics of the communication partner</b>
<b>say</b>	<b>to listen and listen</b>	<b>to observe (non-verbal aspect)</b>

The success of business communication of the head is largely determined by the idea of the existing barriers to communication. Their knowledge helps the Manager to improve the quality of communication, more successfully achieve their goals. Consider in more detail the barriers to productive communication. The first group of communication barriers is personal barriers.

The barrier of temperament arises as a result of the meeting of two people with different types of nervous system. Temperament is the natural basis of identity. Man is born and dies with the same temperament, i.e. during the life temperament does not change. Temperament is most vividly manifested in unusual situations. Often a person has not even spoken a word yet, but has all about himself “said” means of non-verbal communication (pose, gesture, facial expression, facial expressions).

Herluf Bidstrup-a well-known Danish cartoonist perfectly reflected this in his drawings. He depicted a man sitting on a bench reading a newspaper. Next to the man on the bench rests his hat. Next is a series of sketches of people's reactions to that passerby sits on the hat, not noticing her. In one picture, a man throws thunder and lightning, ie, shows his reaction very rapidly. On the second – with a smile invites a hapless passerby to communicate (God bless her hat, she still will not return). On the third – the man continues to read the newspaper unperturbed, and on the fourth-we see the unfortunate person, all the kind of the speaker: "Everything was gone how I will live without my hat?"

So the artist talented showed the reaction of people with different types of temperaments: choleric, sanguine, phlegmatic and melancholic.

It is established that each of four types of temperament is caused by a certain combination of such properties as force – weakness of nervous system, its mobility – inertia, balance – unbalance.

All human relations are determined primarily by temperament. Its role in making complex managerial decisions is also great.

In psychology, there are methods and tests to determine the temperament, but the observant is able to determine the temperament of other people, based on the characteristics of their behavior in activity and communication. Help in this can the table below, which describes the types of behavior of people of different temperaments.

Barrier accentuation personality. A source of conflict and resentment is the discrepancy between self-identity and others.

The second group of communication barriers is the barriers of communication manners.

Dominant subject of communication-he does not care about the relevance of treatment to anyone, he may not answer the question. He seeks to seize the initiative, assertive, interrupts, raises voice, repeatedly saying the same thing.

The barrier of contempt limits contacts with the person who caused negative emotions. Contempt is usually caused by acts incompatible with our idea of the accepted standards of behavior, repulsive traits (cowardice, betrayal, avarice), prejudices, etc.

The barrier of fear is one of the most hard to bear down barriers of communication. He encourages people to minimize and stop all communication.

The barrier of shame and guilt arises in response to criticism, irrepressible praise, flattery, from the fear of being awkward or being caught in something, etc.

Bad mood barrier. A bad mood often destroys fellowship.

The barrier to misunderstanding of the importance of communication is the next barrier to business communication. This barrier arises when managers feel that it is not necessary to provide information to subordinates, as well as when they underestimate the socio-psychological aspects of human leadership. It should be reminded that the lack of information generates rumors, as people tend to fill the information field, "satisfy the hunger for information."The barrier of incorrect mindset also destroys business communication. A setup is a readiness to act according to the situation. "Incorrect installation" occurs when it is deformed.

Barriers to business communication and stereotypes that are associated with stable, simplified opinions about people, events.

Stereotypes create barriers to communication in two ways:

the meaning of information can be distorted by the speaker;

the meaning of information is distorted by the stereotypical thinking of the listener.

The barrier of speech, as a result of speech mistakes, does not contribute to the improvement of business communication.

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URL: [https://vuzlit.ru/314904/problemu\\_delovogo\\_obscheniya\\_v\\_rossii](https://vuzlit.ru/314904/problemu_delovogo_obscheniya_v_rossii)

**Аннотация.** От искусства делового общения руководителя зависит качество работы, эмоциональный настрой работников, стабильность кадрового состава, социально-психологический климат в организации, наличие конфликтных ситуаций, установление и развитие деловых контактов, влияющее на экономическую ситуацию организации в целом.

**Ключевые слова:** деловое общение, манера, стиль общения; барьеры общения; каналы восприятия партнера по общению.

**Summary.** The quality of work, emotional mood of employees, stability of personnel, socio-psychological climate in the organization, the presence of conflict situations, the establishment and development of business contacts, affecting the economic situation of the organization as a whole, depends on the art of business communication of the head.

**Key words:** business communication, manner, style of communication; communication barriers; channels of communication partner perception.

## SECTION 6: PHYSICS AND BIOLOGY



UDC 520.1

### **THE INFLUENCE OF ARTIFICIAL SKY LIGHTING ON ASTRONOMICAL OBSERVATIONS**

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How glorious in the middle of the night to look up into the sky and see the abyss of stars... However, nowadays, given the light smog (exposure), this is difficult to do.

Light pollution (illumination) - the illumination of the night sky by artificial light sources, the light of which is scattered in the lower layers of the atmosphere, interfering with astronomical observations and changing the biorhythms of living beings.

The phenomenon of "illumination" of the night terrestrial sky by artificial sources of illumination is increasingly hampered by astronomical observations. Over the past hundred years, due to the rapid development of the application of electric lighting of settlements, astronomical observatories, once built in or near cities, have lost their significance. And lately the problem of light "pollution" has risen very sharply. This phenomenon not only prevents astronomical observations from

observatories in these regions, but also has some influence on the whole of mankind. Lanterns, bright signs and other light sources seriously worsen the visibility of the night sky and prevent astronomical observations, and astronomy is very sensitive to artificial sky illumination. Naturally, the main epicenter of light pollution is the city. So from large cities you can see only bright stars, the Moon and some planets (Mercury, Venus, Mars, Jupiter and Saturn), and it becomes very difficult to observe objects of distant space: star clusters, nebulae, galaxies, etc. In addition, it becomes impossible to determine the contours of the constellations, since many of them include faint stars. If we leave the city for several kilometers, the light will not be lost, but it will weaken slightly. The farther from the epicenter, the darker and the better is the sky. That is why most observatories are located high in the mountains, away from the epicenter of light smog. However, before the construction of observatories, in addition to the background glow of the atmosphere, several other factors should be taken into account, namely, air transparency, the degree of its homogeneity (affecting the clarity of the image of objects), diurnal temperature changes and wind force. So some old observatories, for example, Dunlop in Ontario (Canada), Mount Wilson in California, Pulkovskaya (St. Petersburg) and Moscow are greatly tormented by urban sky-light. To avoid the same light, lanterns with closed lamps are allowed, guiding light only downwards. In this case, the light source itself remains invisible from the side, unlike ordinary street and yard lamps. In addition, there is a significant energy savings due to reduced light losses. An important role in preserving the darkness of the night sky is played by working with the population. Government officials, city lighting specialists and, of course, astronomers are the main force in resolving this issue. It is necessary to "cover" this problem, develop clear recommendations and bring them to the public. There is InternationalDark-SkyAssociation, IDA. It is a non-profit, tax-exempt organization striving to bring the problem to citizens and convince them not to flood the neighborhood with light, to keep the dark sky and at the same time maximize the quality and efficiency of outdoor lighting.

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**Аннотация.** Как славно посреди ночи поднять взгляд в небо и узреть бездну звезд, затеряться в этих далеких галактиках, судорожно ища знакомое созвездие. Однако нынче, учитывая световой смог (засветку), это сделать трудно. Рассмотрено явление "засветки"

ночного земного неба искусственными источниками освещения, которое все больше мешает проводить астрономические наблюдения. Отмечено, что за последние сто лет в связи бурным развитием применения электрического освещения населенных пунктов астрономические обсерватории, некогда построенные в городах или вблизи них, потеряли свое значение.

**Ключевые слова:** засветка, световой смог, световое загрязнение, звездное скопление, обсерватория.

**Summary.** How glorious in the middle of the night to look up into the sky and see the abyss of stars. However, nowadays, given the light smog (exposure), this is difficult to do. The phenomenon of "illumination" of the night terrestrial sky by artificial sources of illumination is increasingly hampered by astronomical observations. Over the past hundred years, due to the rapid development of the application of electric lighting of settlements, astronomical observatories, once built in or near cities, have lost their significance.

**Keywords:** illumination, light smog, light pollution, star cluster, observatory.

UDC 574

## **THE INDIVIDUAL-BASED MODELS OF MARINE ECOSYSTEMS**

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### **Introduction.**

Ecological models, as a rule, have a set of assumptions. Often the same living period of individuals, homogeneity of population as a context of conditions of habitat – are the conventional assumptions. This approach states, that individuals of the same age get the same food, have the same risks of life, their velocity of reproduce and mortality are also the same. To describe population dynamics researchers usually uses different median values and besides this often they use the same characteristics for individuals of one strain, despite the fact that population can be different physical and food conditions. In other words ecological models do not take into account individual variation of individuals in population and also heterogeneity of conditions of their existence.

The diversity of research shows that in nature the high variation of

individual characteristics of individuals, which belongs to the same population, takes place. Population behavior changes under different physic-chemical conditions. It is influenced by competition for resources, change of levels of fertility and mortality, the term of lifestyle and etc. Clearly, such changes can substantially influence for population dynamics of all ecosystem. In this way, using classical ecological models, that operate the average values, is not always correctly. One of the way to achieve more detailed description of biological compounds of ecosystem is using individual-based modelling [1, p. 431]. This way of ecological modelling actively has been developing during the last decades. IB-models are simulation models, which give an opportunity to study population dynamics like the result of many local interactions between individual and get integral characteristics of population by averaging of a set of local characteristics [2, p. 576]. It allows determine relationships between individual characteristics of one unite of population and the all population. Today IB-models are common not only in ecology, they are also popular in biology, economics, sociology, biophysics. All of this sciences attempt to include in models individual traits of one unit of all population.

IBM have benefits over traditional ecological models, because it gives an opportunity to describe a behavior of all population, basing on defined traits of individuals. IB-models sufficiently universal, they can work on any time scale, shows dynamics of systems with a plenty of elements, taking into account their individual behavior. Such models are based on individual logic of behavior of the participants of the process, which forms the behavior of all system. It is good, because allows create models without knowledge about common connections between individuals of all population.

The goal of this research is definition how we can use IBM for marine ecosystems, for understanding biological processes, that is for achieving more accurate describing of ecosystem by taking into account individual traits of organisms.

### **Principles of individual-based modeling**

IBM, in contrast of traditional ecological modeling, is conducted in an ascending direction. The construction of IB-models follows the path of gradual complication of the description of the ecosystem. At the first stage, physiological characteristics, a response to the conditions of existence, parameters of interaction between individuals of one species are mathematically described. When the description of the dynamics of one species is completed, it is possible to include new dependencies and parameters that show the features of the interaction of this species with others. Such models are useful for describing the competitive behavior

between individuals of the same species, interspecies competition, for the presentation of complex ecosystems, including trophic chains with some levels. As for the traditional ecological modeling, it often goes in the opposite direction: the simplified model of the ecological system is gradually "clarified". New details and characteristics are added at each stage to the already adopted concept of the model. Both approaches have their advantages and disadvantages, but it is clear that to describe the dynamics of large ecological communities it is more useful to use IBM methods, because they allow to model individual parts of the system, and then to unite them into a one model, which can describe the entire community as a whole.

Advantages of IBM over traditional models are shown in many studies related to different fields of knowledge. For this review, about two dozen articles were analyzed, and then ten were selected in order to focus on one issue: "What are the benefits of using IBM methods to describe the dynamics of processes, which occur in marine communities?". For convenience, we will divide the articles into two groups: review articles with analysis and practical recommendations for modeling, and articles with description of IBM for specific marine ecosystems.

The first group will be used to trace how the methods of IBM have evolved since it became a separate direction for modeling biological communities. According to [3, p. 133], IBM elements can be seen in ecological models of the seventies of the twentieth century, however, as a separate direction of modeling of ecological systems, IBM was singled out in 1988 after the appearance of the article by M. Huston and co-authors "New computer models unify the theoretical ecology" [4, p. 686]. This article contained a fully justified prediction that IBM would receive rapid development and widespread application everywhere "for two decades". Actually, since the publication of this article, there has been an increase in the number of studies on this direction, which continues to this day. V. Grimm in [3, p. 135] presented an overview of the articles for period about 20 years since 1980. The analysis of publications allowed the author to formulate a number of practical recommendations that will be useful to any ecologist, who want to create IB-models:

- it is necessary to develop as simple as possible models, gradually complicating them;
- remember that you must not add in the model a lot of properties that are characteristic of a small number of individuals and do not determine the behavior of the system as a whole;
- the aim of the IBM should be an understanding of the processes, which occur in the system, but not the constructing the model;



- care must be taken in every possible way to verify the model to ensure that the results of the simulation match the data of experimental studies.

To describe real systems, it is necessary to develop more complex based on an individual-based approach models. Today there are a lot of works, which are related to this problem. We chose four [5-8], the results of which can be used to simulate the population dynamics of small marine communities.

One of the difficulties of modeling is the determination of the number of parameters and empirical values that must be included in the system in order to adequately describe its behavior in accordance with the stated goal of the study. The study [5, p. 2] is devoted to this problem. The authors associate the description of the model in a mathematical language with Kolmogorov complexity (in the algorithmic information theory the Kolmogorov complexity of the object is a measure of the computational resources, which are necessary for the precise determination of this object [9, p. 8]). It is proposed to use methods similar to those used to solve Kolmogorov complexity for a complete description of the system.

Work [6, p. 11] proposes to divide the process of constructing the IB-model of the ecological population into 4 stages: a description of the physico-chemical properties of the system, the compilation of the general concept of the model, its presentation in mathematical form, and, finally, the development of a computational model for the chosen programming environment. The ways of adding complexity in the model and their impact on the behavior of the system as a whole are considered in detail. Also, the authors presented three types of "object-oriented" models: an individual model, an agent-based model and a cellular automatic model. For each model they gave detailed description of various computing approaches and computing platforms that allow analyzing the results obtained. The described methods and approaches can be applied in the construction of IB-models of marine ecosystems.

There are a number of difficulties in modeling ecological communities containing several trophic levels. First of all this is due to the lack of criteria for resolving the issue of including certain "details" in the system. In [7, p. 8], the authors gave our attention to the study of the relationship between the detailing of the model and its performance. During they were analyzing simple models of marine systems, it appeared an opportunity to formulate logical recommendations on what details should be included in the model, and which ones should be excluded. The authors show how, using the principles of IBM, to perform a step-by-step construction of a unified ecological model that includes a description of the various processes

of vital activity of the biological components of the ecosystem in interaction with the external environment.

The study [8, p. 130] is an overview of articles which deals with the modeling of the fish population. This article is useful in that it provides an assessment of the findings of numerous studies of marine communities using IBM methods. The authors divide the material into three groups: descriptive articles; studies, which show the impact of a particular process on the dynamics of the system; studies with different model concepts. The authors made a conclusion that the most useful are the conceptual studies on IBM, as they can give ideas for future ecological models.

### **Individual-oriented modeling of marine ecosystems.**

Let us now turn to the actual IO models of marine ecosystems. A biophysical model is presented in [10, p. 15], it includes a description of the hydrodynamic processes (upwelling) and functioning of the ecosystem, the living organisms of which form a multilevel trophic chain. The model is designed for zooplankton, but the same construction principle can also be used to description fish populations. The authors present the results of two- and three-dimensional numerical experiments to simulation the functioning of the lower trophic levels of ecosystems. Simulation of the spatiotemporal distribution of animals of higher trophic levels is built on the principles of IBM to take into account physiological and behavioral effects that can not be taken into account in classical ecological approaches. The authors developed three blocks: a model, which describes the density of distribution of living organisms at different depths and two models, which reproduces the dynamics of populations of organisms at lower and higher trophic levels. After combining these three blocks, a single biophysical model was obtained. It reproduces the observed spatio-temporal changes in the ecosystem under the influence of external factors (wind, surface heat flux and matter, etc.), taking into account the characteristics of the environment (temperature, salinity, bottom relief). The construction of this model became possible only through the application of the principles and methods of IBM.

In the nineties of the twentieth century, the unusual effect of changing the number of cod populations in the area of the George Bank, which separates the Maine from the main depression of the Atlantic Ocean attracted scientists from all over the world. Despite the fact that in 1993 the fodder base was significantly higher than in 1994, the number of fish in 1994 reached higher values. In order to explain this phenomenon, researchers developed a biophysical model that includes the assumed factors that led to the observed case. The results are presented in [11, p. 250]. Using the IBM methods, besides the classical factors, the

influence of light and temperature on the growth and distribution of larvae and other physiological features of cod was included in the model. After completing the model studies, the scientists concluded that the increase in the number of cod is due to the increased resistance of the larvae to infection due to the higher water temperature in 1994.

An individual-based model of the dynamics of the *Euterpina acutifrons* Dana (Copepoda: Harpacticoida) population is presented in [12, p. 235]. In this model, the processes of consumption, assimilation, respiration, excretion and reproduction are described mathematically. It is good, that the description is different for each stage of development of copepods. The model was based on the assumption that for copepods the process of consumption and digestion depends on temperature; the weight of the individual and the cumulative specific growth rate control the molting process; molting starts at a fixed weight and does not depend on temperature. The obtained results of imitation experiments are confidently consistent with experimental data on the dynamics of the population of *E. acutifrons* at different water temperatures and food concentrations. Because of the individual-based approach, a biophysical model was obtained that allows to follow the development of organisms that are at different stages of development, as well as the increase (decrease) in the duration of the developmental stages, depending on the temperature.

A study similar to [12] was carried out in [13, p. 223]. The aim of the work was to identify the relationship between physiological processes (consumption, assimilation, excretion, oogenesis, etc.) and processes, which control the number of individuals of the same age at each stage of development of organisms (mortality, molting rate, multiplication). The results of the simulation gave an opportunity to conclude that if organisms remain for a while at the same stage of development, their growth rates slow down. Also the mortality for this group of individuals increases. The model obtained confirms the assumptions, which were advanced in [12, p. 230]. Such mathematical model can be used in various conditions (including changing) since it not only imitates biophysical processes under constant external conditions, but also describes the internal dynamics of the population in sudden changes of the environment.

The determination of the duration of each stage of development of copepods is the result of [14, p. 235], which is also relates to the same issues. The authors showed that the development of the copepod community is not a random process, but depends on certain physiological processes at the individual level. To achieve the results described in [12-14], IBM methods were used, since only they allow to take into account the individual features of organisms forming ecological communities.

Thus, individual-based modelling is a new approach for ecological modelling. IBM allows to describe in detail a lot of processes of ecosystem. The main advantage of IBM over traditional ecological modelling is opportunity to disclose the nature of observed process, while traditional ecological modelling operates only mean values and, as a result give the inaccurate picture of ecosystem dynamics. So, in near future we will be witnesses of wide use individual-based models for imitation models of different marine ecosystems.

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**Аннотация.** В статье представлен обзор исследований, упрощающих понимание новой области экологического моделирования - разработка индивидуальных моделей (IBM). IBM строится по принципу "вниз-вверх": от небольших объектов до уровня экосистемы или населения. IBM позволяет представлять систему, смоделированную как набор взаимосвязанных единиц. Каждый объект, в свою очередь, имитирует функции и поведение отдельного индивида (или группы идентичных индивидов), имеющего свой род, возраст, стадию развития, уровень жизни, различные скорости физиологических процессов. Динамика численности населения представляется следствием деятельности отдельных особей. IBM имеет много преимуществ перед традиционным экологическим моделированием, поскольку дает возможность учитывать индивидуальные особенности.

**Ключевые слова:** индивидуальные модели, объектное моделирование, индивидуальная вариация.

**Abstract.** This article gives a review of research, which simplify understanding of new area of ecological modelling – design individual-based models (IBM). IBM is been constructing on the principle “down-up”: from small objects to the level of ecosystem or population. IBM allows represent system modelled like a set of units interrelated. Each object in its turn mimics functions and behavior of single individual (or group of identical individuals), that has his own sort, age, stage of development, level of live, different velocities of physiological processes. Population dynamics appears like consequence of activities of single individuals. IBM has many advantages over conventional ecological modelling, because it gives an opportunities to take into account individual characteristics of individuals.

**Key words:** individual-based models, object-based modeling, individual variation.

UDC 910.1

## **THE ICE REGIME OF THE SEA OF AZOV IN THE CONDITIONS OF MODERN CLIMATE CHANGE**

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Some scientists believe that physics can tell us what to expect from the world.

The goal of physics is to understand the world in the present days. Physicists want to know things behavior or why the world works the way it does. Using that knowledge, it is often possible to learn more about the world around you than you originally knew. We can't see black holes, but due to the knowledge we can find other ways to look for black holes. We know that matter around a black hole will behave in a certain way, so we study that behavior. This kind of discovery requires that we find the rules and equations that describe the world; that make it run. Some scientists are even searching for a single equation, a "theory of everything," from which all other equations could be derived. Could such an equation predict the future?

We can't predict how things will behavior in general or that we can't use those predictions to our advantage. We can't predict the path of a single electron, but we can still utilize electricity. We can still count on our computers to work. And as science progresses, we can study more things. In essence, there are fundamental rules and regulations for the universe - like the force of gravity – that help us to understand physics. But can it predict the future?

Some scientists believe that fundamental rules and regulations can't predict the future. But what about Moore's Law? It is considered by scientists to be an example of predicting the future. So with Moore's Law, scientists are, in a way, predicting the future. Moore's Law doesn't tell us who will come out with the faster processor first, or what they'll eat for breakfast the day they announce it.

To determine the influence of physics on glaciation we should study the problem actuality and research works on glaciation and glaciers. Interactions between ice sheets and the ocean and atmosphere, paleoclimate reconstruction using ice cores, Quaternary climate history and the ice ages were studied by K.M. Cuffey and W.S.B Paterson [4]. The earth's cryosphere was researched by V.P. Singh, P.Singh and U.K. Haritashya [5].

Professor Alan J. Thorpe, of the Institute of Physics explained how predictions of future climate change are made using climate models [3]. He stated that climate change was one of those issues where science is crucial in determining government and international policy-making. "Climate change is a fundamental problem involving basic science including physics. There is much research still to be done before we get to a position of sufficient certainty about all the aspects of climate change that are required by society to plan for the future. Predictions of future climate change, based on numerical global climate models, are the critical outputs of climate science" [3, p.6].

Being able to predict the outcome of the research is the touchstone for whether it is necessary to understand physics. "Weather forecasting is the best place to start because the forecasts are more familiar and the methodology is very similar in many important ways to climate prediction. A weather forecast involves numerically integrating forward in time equations that describe the evolution of the atmosphere starting from a set of initial conditions. The equations used are the classical laws of (fluid) mechanics and thermodynamics that are known to apply well to the atmosphere. The numerical solutions require the atmosphere to be divided up into a large three-dimensional lattice of grid points at which the atmospheric variables are held in the model and on which the equations are solved using finite numerical approximations. The initial conditions arise from global measurements of the state of the atmosphere interpreted using a prior short-range forecast of that state using the model forecast system" [3, p.7].

The ice regime of the Sea of Azov and climate was studied by G.G. Matishov, A.L.Chikin, L.V. Dashkevich, L.G. Chikina and others.

Due to the shallow water of the Sea of Azov and small heat storage ice conditions at sea are subjected to quite sharp fluctuations due to weather changes. During periods of ice cover formation and purification of the waters of the ice the repeated appearance and disappearance of ice is possible, the alternation of the processes of melting and freezing. The ice season in the Sea of Azov begins with the appearance of ice at the top of the Taganrog Bay. Low salinity causes the beginning of ice formation at the water temperature of  $-0.5^{\circ}\text{C}$ . Average number of days with ice in the Taganrog Bay contains 75-100 [1]. "Changes in the ice cover of the sea of Azov are due to the natural Cycling of the climate. During the last decade the climate in the South of the European territory of Russia was characterized by alternation of severe and mild winters" [2, www].

The climate of the Sea of Azov, which deeply penetrates into land, is continental. It is characterized by cold winters, and dry and hot summers.

Seasonal changes in the sea level mainly depend on the regime of the riverine runoff. The annual sea level change is characterized by its rise in the spring–summer months and a fall in the autumn and winter with average total range of 20 cm.

The currents in the sea are mostly induced by the wind. In the Sea of Azov, ice is formed every year; in so doing, the ice coverage (sea area covered with ice) strongly depends on the character of the winter (severe, moderate, or mild). In moderate winters, ice is formed in Taganrog Bay by the beginning of December [7].

In the area of Sea of Azov occurrence of moderate winters is 42 %, soft - 48%, severe - 10%. The gradual rise of temperature change was manifested in harsh winters. Number of mild winters has increased markedly. Impermanence ice conditions depending on the severity of winters are the main feature of the ice regime of Sea of Azov.

Ice formation in Sea of Azov occurs annually. The freeze lasts for 2-5 months. Ice formation, usually begins in Taganrog Bay in late November. In the north, north-east of the sea ice appearance date range varies from mid-October to mid-January, depending on the severity of the winters.

Home ice formation in the coastal settlements in the west and east of the Azov Sea is in December. Date range of the first ice formation in these areas is 3.5 months. Earliest ice formation is observed at the beginning of November, and the latest - in mid-February [6].

In the Sea of Azov, ice is formed every year. The ice coverage (sea area covered with ice) depends on the character of the winter. During December, fast ice is formed along the north coast of the sea.

In Taganrog Bay, the resulting water transport is controlled by the runoff of the Don River and is directed from the bay toward the sea. Under northerly winds, the current flows from the Sea of Azov to the Black Sea in the Kerch Strait; winds with a southerly component provide the supply of the Black Seawaters to the Sea of Azov (see fig. 1).

Thus, the sea area covered with ice depends on the character of the winter (severe, moderate, or mild). In moderate winters, ice is formed in Taganrog Bay in December, and fast ice is formed along the northern coast of the sea and somewhat later along its other coasts. Throughout the winter, the ice conditions feature instability. The mutual replacements of the cold and warm air masses and wind fields over the sea caused repeated breaking and drifting of ice fields and their hummocking. As a rule, during mild winters, the central part of the sea is free from ice; it may be observed only in bays and lagoons along the coasts.



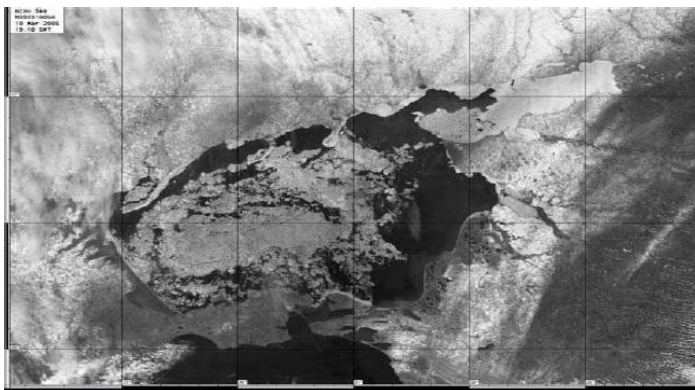


Fig.1 – Ice in the Sea of Azov revealed from a MODIS-Aqua satellite image.  
Image courtesy of D.M. Soloviev, Marine Hydrophysical Institute, Sevastopol.

In conclusion it should be noted that the prospect of further research is represented by practical ones of the ice regime of Azov Sea in the conditions of modern climate change.

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**Аннотация.** На основе теоретических данных научных наблюдений дана оценка основных гидрологических характеристик Азовского моря. Показаны особенности сезонных и межгодовых изменений под действием природных и антропогенных факторов. Подробно проанализировано формирование льда в Азовском море.

**Ключевые слова:** Азовское море, льдообразование, прогнозирование погоды, зима, кочкование, низкая соленость, ледовые условия.

**Summary.** Based on the theoretical data of scientific observations, principal hydrological characteristics of the Sea of Azov are assessed. Features of the seasonal and interannual variations under the action of natural and anthropogenic factors are shown. Ice formation in the Sea of Azov is analyzed in detail.

**Keywords:** the Sea of Azov, ice formation, weather forecasting, winter, hummocking, low salinity, ice conditions.

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## THE ROLE OF VARIABLE STARS IN THE STUDY OF THE UNIVERSE

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*Variable stars* are stars that can change their brightness over time. Volatility occurs for various reasons, but two types can be distinguished: internal and external variable stars.

The internal variables include pulsating stars. The change in their brightness is due to a change in volume behind the uneven balance between the forces of gravity and the internal pressure of the gas.

*Rotating variable stars* are stars, the distribution of brightness over the surface of which is inhomogeneous. This heterogeneity of brightness can be caused by the presence of spots.

*Cataclysmic variables stars* – their brilliance is due to complex processes in binary star systems. A substance from the surface layers of a less dense star begins to flow to the other, accumulates on the surface, heats up and thermonuclear reactions begin, resulting in an explosion that causes

variability.

*Eruptive variable stars* manifest their variability in the form of repeated flares in a state that can be explained by various ejections (eruptions) as a result of changes in the shell or interactions with the interstellar medium.

*Eclipse-variable stars* – this type of variable stars refers to external variables. The change in brightness occurs when one star closes the other while moving. We can see this eclipse only when the plane of the orbit of two stars coincides with the plane of our line of sight.

Variable stars continue to play in our understanding of the universe. Flares Supernovae lead to the enrichment of heavy elements of interstellar space, which makes it possible to form planets with hard shells. It is unlikely that life could have formed if there were no elements heavier than hydrogen and helium in the protostellar cloud.

New stars show regular flares at intervals of tens to hundreds of thousands of years, which is explained by thermonuclear explosions in their atmospheres as the hydrogen-rich substance falls on them. Eclipse-variable stars are the best laboratories for determining not only temperatures, but also masses. Cepheid played an important role in determining distances to distant galaxies and determining the age of the universe. The accretion disks of cataclysmic variables help us understand the behavior of disks on an even larger scale, as do processes inside the nuclei of active galaxies with supermassive black holes. Even the search for extraterrestrial life is connected with the study of variable stars. Transits of planets outside the solar system help to understand the processes of formation of planets and life itself. And, as we know, the heavy chemical elements are necessary for life.

Variable stars are necessary in order to study the history of their behavior. But the number of variable stars exceeds the number of professional astronomers. In addition, it is difficult to imagine centuries of observations of an object by one of the astronomers on a single telescope.

Thus, non-professional astronomers make a real and very useful contribution to science with their observations of variable stars. These data are important for the analysis of the behavior of changes in stars.

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**Аннотация.** Каждый любитель астрономии хоть раз в своей жизни мечтал совершить открытие своими руками. Поиск переменных звёзд – это та самая область астрономии, в которую может внести свой вклад каждый, испытывающий влечение к космосу. Рассмотрены открытия новых переменных звёзд. Автор характеризует переменные звёзды, их типы.

**Ключевые слова:** переменные звёзды, яркость, Вселенная, астрономы-любители, Сверхновая.

**Summary.** Every non-professional astronomer, at least once in his life, dreamed of making a discovery with his own hands. The search for variable stars is the area of astronomy, in which everyone can contribute, feeling attraction to the cosmos. The discovery of new variable stars is useful for exploring the universe. So what are the variable stars, what types are they? For all these questions there is an answer in this article.

**Key words:** variable stars, brightness, Universe, non-professional astronomers, Supernova.

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## WHAT IS QUASARS

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A quasar (quasi-stellar object or QSO) is an active galactic nucleus of very high luminosity (the term "quasar" was coined by Chinese-born U.S. astrophysicist Hong-Yee Chiu in 1964). A quasar consists of a supermassive black hole surrounded by an orbiting accretion disk of matter. As matter in the accretion disk falls toward the black hole, energy is released in the form of electromagnetic radiation. Quasars emit energy across the electromagnetic spectrum and can be observed at radio, infrared,

visible, ultraviolet, and X-ray wavelengths. The most powerful quasars have luminosities exceeding  $10^{41}$  W, thousands of times greater than the luminosity of a large galaxy such as the Milky Way.

### **The discovery of quasars**

In 1932, American engineer Karl Jansky (1905– 1945) discovered existence of radio waves emanating from beyond the solar system. By the mid-1950s, an increasing number of astronomers using radio telescopes sought explanations for mysterious radio emissions from optically dim stellar sources.

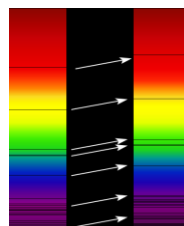
In 1962, British radio astronomer Cyril Hazard discover strong radio emissions traceable to the constellation Virgo. Optical telescopes pinpointed a faint star-like object (lately named 3C273-3) as the source of the unusual emission spectrum.

American astronomer Allan Rex Sandage first reported several faint star-like objects as optical counterparts to radio sources in 1960. In 1963, Dutch-American astronomer Maarten Schmidt explained, that redshift is the Doppler-like shift of spectral emission lines toward longer (hence, redder) wavelengths in objects moving away from an observer. Observers measure the light coming from objects moving away from them as redshifted. Most importantly, the determination of the amount of an object's redshift allows the calculation of a recession velocity. If the speed of light, redshift and Hubble's constant are known, the distance to an object be able to calculate. After 3C273, many other quasars were discovered with similarly redshifted spectra.

Schmidt's calculation of the redshift of 3C273 spectrum meant that 3C273 was approximately three billion light-years away from the Earth. It became immediately apparent that, if 3C273 was so distant, it had to be many thousands of times more luminous than a normal galaxy for the light to appear as bright as it did from such a great distance. Refined calculations involving the luminosity of 3C273 indicate that, the quasar is actually two trillion times as bright as the Sun. The high redshift of 3C273 also implied a great velocity of recession measuring one-tenth the speed of light.

### **Properties of quasars**

Because quasars are between 600 million and 28.85 billion light-years away, any light, which reaches the Earth, is redshifted. Quasars inhabit the very center of active, young galaxies, and are among the most luminous, powerful, and energetic objects known in the universe, emitting up to a



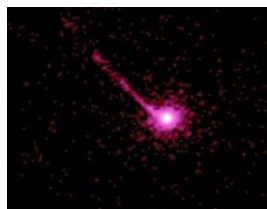
Absorption lines of distant galaxies (right), of the Sun (left). Arrows indicate redshift.

thousand times the energy output of the Milky Way. Despite all this, most quasars cannot be seen with small telescopes.

The luminosity of some quasars in the optical range and in the X-ray range changes very fast. This fact defines an upper limit on the volume of a quasar: quasars are not much larger than the Solar System. This implies an extremely high power density.

The matter, accreting onto the black hole, will have some angular momentum around the black hole that will cause the matter to collect into an accretion disc. This phenomenon makes luminous versions of the general class of objects known as active galaxies. The most of galaxies have a central black hole in their nuclei, but only a small fraction are active (with enough accretion to power radiation).

The emission of large amounts of power from a small region requires a power source far more efficient than the nuclear fusion that powers stars. The release of gravitational energy by matter falling towards a massive black hole is the only process known that can produce such high power continuously. Therefore, quasar's jets outflows of ionized matter are emitted as an extended beam along the axis of rotation of quasar. In many cases, it is likely that the brighter the quasar, the more directly its jet is aimed at the Earth.



Picture 1 – X-ray image of the quasar's jet, which extends at least a million light years from the quasar

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**Аннотация.** Квазары находятся на очень широко варьирующемся диапазоне расстояний (соответствуя красным смещениям  $z < 0.1$  для ближайших квазаров и  $z > 7$  для наиболее отдаленных известных квазаров). Пиковая эпоха активности квазаров во Вселенной

соответствует красным смещениям около 2, или приблизительно 10 миллиардов лет назад. По состоянию на 2017 год наиболее отдаленным известным квазаром является ULAS J1342+0928; свет, наблюдаемый из этого квазара, был излучен, когда Вселенной было только лишь 690 миллионов лет. Может быть, если человечество исследует этот тип черных дыр, мы получим ключ к пониманию того, как была создана Вселенная.

**Ключевые слова:** черная дыра, квазар, аккреционный диск, смещение Доплера, закон Хаббла, джеты, светимость, активные галактики.

**Summary.** Quasars are found over a very broad range of distances (corresponding to redshifts ranging from  $z < 0.1$  for the nearest quasars and to  $z > 7$  for the most distant known quasars). The peak epoch of quasar activity in the Universe corresponds to redshifts around 2, or approximately 10 billion years ago. As of 2017, the most distant known quasar is ULAS J1342+0928; light observed from this quasar was emitted when the Universe was only 690 million years old. Maybe, if humanity explore this type of black holes, we will get a key to comprehension, how the Universe was made.

**Keywords:** black hole, quasar, accretion disc, redshift, Hubble relation, jets, luminosity, active galaxies.

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## BLACK HOLES

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In this article, we are going to discuss some of the most interesting and at the same time mysterious phenomena – Black Holes.

What is a black hole?

A black hole is a region of space-time, the gravitational attraction of which is so great that even objects moving at the speed of light, including quanta of light itself, can not leave it.

How do black holes appear?

Originally, a black hole is a star. At the end of life, stars have three variants of evolution:

1. If a star has a mass of up to ten solar masses, then at the end of its life path the star enters the stage of the red giant. The launching of helium thermonuclear and other reactions, each time leads to significant transformations of the star.

In a sense, this is a dying agony. The star then expands hundreds of times and turns red, then shrinks again. Luminosity also changes – it increases thousands of times, then decreases again.

At the end of this process, the outer shell of the red giant is dumped, forming a spectacular planetary nebula. In the center a naked core remains – a white helium dwarf with a mass of approximately half the solar and a radius roughly equal to the radius of the Earth.

2. If a star has 10 to 30 solar masses, then the star does not just drop its shell in the final, but frees up the accumulated energy in a powerful thermonuclear explosion – a supernova.

In the heart of remnants of the supernova scattering the stellar matter with huge force for many light years around, there is in this case no longer a white dwarf, but a super dense neutron star, with a radius of only 10-20 kilometers.

3. However, if the mass of the red giant is more than 30 solar masses (or rather, the supergiant already), and the mass of its core exceeds the Oppenheimer-Volkov limit, which is approximately 2.5-3 mass of the Sun, then no white dwarf or neutron star is formed.

In the center of the supernova remnants, something much more impressive appears – a black hole, since the core of the exploding star shrinks so much that even neutrons begin to collapse, and nothing more, including light, can escape from the limits of the newborn black hole – or rather, its event horizon [2, p.1].

How do Black Holes look and why is it called "black"?

Let's recollect how we see objects: the type and color of the object, it is nothing more than the light reflected from this object into the optical lock in our eyes. As mentioned above, even the light cannot escape from the Black Hole, which means that the photons will not fall into our eyes, and we will not see anything. No one has ever seen a black hole, it is depicted with a black center with a distorted space around it, but this is only to make it easier to understand its appearance. We can fix its gravitational force on the space near ourselves, and, perhaps we will see this distortion of the space around it, but no more.

How to detect black holes?



Black holes do not radiate anything, not even light. However, astronomers have learned to see them, or rather, to find candidates for this role. There are three ways to detect a black hole.

1. It is necessary to follow the circulation of stars in clusters around a certain center of gravity. If it turns out that there is nothing in this center and the stars spin around empty space, one can confidently say: in this "emptiness" there is a black hole. It is for this reason that the presence of a black hole in the center of our Galaxy was assumed and its mass was estimated [4, p. 598].

2. A black hole actively absorbs matter from the surrounding space. Interstellar dust, gas, matter of the nearest stars fall on it in a spiral, forming a so-called accretion disk, similar to the ring of Saturn (Fig.1). Approaching the Schwarzschild sphere, the particles experience acceleration and begin to emit in the x-ray range. This radiation has a characteristic spectrum, similar to the well-studied radiation of particles accelerated in a synchrotron. And if from such a region of the Universe such radiation comes, one can say with certainty – there must be a black hole.



Figure 1.

3. When two black holes merge, gravitational radiation appears (Fig.2). It is estimated that if the mass of each is about ten times the mass of the Sun, then when they merge in a few hours in the form of gravitational waves, energy equivalent to one percent of their total mass will be released. This is a thousand times greater than the light, heat and other energy that the sun has radiated during its entire existence - five billion years. It is hoped to detect gravitational radiation with the help of gravitational-wave observatories [4, p. 598].



Figure 2.

Detection of gravitational waves.

On February 1, 2016, during the press conference of the scientific collaboration LIGO in Washington, it was announced about the experimental discovery of gravitational waves. The existence of gravitational waves has long been known, but experimental detection is an experimental discovery.

To detect these waves, it took patience and caution. The LIGO observatory launched laser beams back and forth along the right-angled four-kilometer knee of two detectors, one in Hanford, Washington and the other in Livingston, Louisiana. This was done in search of coincident extensions and contractions of these systems during the passage of gravitational waves. Using the most modern stabilizers, vacuum devices and thousands of sensors, scientists measured changes in the length of these systems, which are only one thousandth of the size of the proton [1, p. 1].

Now let's talk about one of the most important properties of the Black Hole. It is the horizon of events.

The horizon of events is an imaginary border of space-time, from which nothing can escape. Accordingly, the observer outside the event horizon can in no way get an idea of what is happening in it. The radius of the event horizon is called the Schwarzschild radius.

The body that is inside the event horizon, moves directly to the center of the Black Hole – the singularity. Singularity is a point of space-time, with a certain radius, in which gravitation tends to infinity.

Hawking radiation.

Classical physics believes that the gravitational force of a black hole is so strong that it absorbs everything in itself, but does not release

anything outside. Stephen Hawking also suggested that there is a black hole radiation, which was called Hawking radiation. This radiation is possible if we consider the situation in terms of quantum mechanics – pairs of quanta emerge from a black hole, and possess the property of quantum entanglement. And this phenomenon leads to the fact that the black hole "evaporates" as a result [3, p. 1].

The experiment of Jeff Steinhauer.

The physicist Jeff Steinhauer of the Israeli Institute of Technology in Haifa recorded the radiation predicted by Stephen Hawking back in 1974. The scientist created an acoustic analog of a black hole and showed in experiments that it emits radiation of a quantum nature. The article was published in the journal Nature Physics, briefly about the study reports to BBC News.

To fix this radiation on a real black hole is not yet possible, because it is too weak. Therefore Steinhauer used its analogue – the so-called "blind hole". To model the horizon of the events of the black hole, he took the Bose-Einstein condensate from cooled to near zero absolute temperatures of the rubidium atoms.

The speed of sound propagation in it is very small – about 0.5 mm / sec. And if we create a boundary on one side of which the atoms move with subsonic speed, and on the other – accelerate to supersonic speed, then this boundary will be similar to the horizon of the events of the black hole. Quanta of atoms – in this case phonons – were captured in the experiment by a region with supersonic velocity. Phonon pairs were broken, one was in one area, and the other in another. The correlations fixed by the scientist indicate that the particles turn out to be quantum entangled [3, p. 1].

So, in recent years, our understanding of black holes has changed markedly. Until recently, these objects were considered exotic. Now, astronomers are sure that the universe is full of black holes. According to scientists, there are at least 400 million of holes.

Any black hole seems to be so strange object that even the imagination refuses us when we try to mentally look into its depths, because it does not resemble anything – neither the stars, nor the comet. It looks like a real mysterious miracle!

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**Аннотация.** Статья посвящена самым загадочным космическим объектам – Черным дырам. Авторы рассказывают об их происхождении, свойствах и уникальности. Рассмотрены способы обнаружения Черных дыр. Также в статье описываются эксперимент обсерватории LIGO по обнаружению гравитационных волн и эксперимент Джеффа Штанхауэра по созданию «лабораторной» Черной дыры.

**Ключевые слова.** Черная дыра, сингулярность, горизонт событий, радиус Шварцшильда, гравитация, излучение Хокинга.

**Summary.** The article is devoted to the most mysterious cosmic objects – the Black Holes. The authors tell about its origin, properties and uniqueness. Methods for detecting black holes are observed as well. Also, the article describes the experiment of the LIGO Observatory on the detection of gravitational waves and Jeff Stahnowor's experiment on creating a "laboratory" Black Hole.

**Keywords.** Black hole, singularity, event horizon, Schwarzschild radius, gravitation, Hawking radiation.

UDC 53.087

## STEPHEN HAWKING'S PREDICTIONS

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### *In memory of the great physicist and extraordinary man*

#### *Stephen Hawking*

Today, the world is shocked by the news of the death of the great scientist Stephen Hawking, because he became the founder of cosmology, knew a lot about black holes and the origin of the world, carefully studied the theory of the Big Bang.

Stephen Hawking was an English theoretical physicist, cosmologist and author. He worked on theories regarding Black holes, general relativity,

quantum mechanics and much more. He inspired millions with his work and will missed by many. He understood that humanity was the problem.

Famous physicist died on March 14, 2018. Stephen Hawking advised to look to the future without false optimism: It is humanity that will turn it into a flaming fireball, as it will require a huge amount of electricity to meet all the needs of the earthlings. Because of the near Apocalypse on Earth, a person should find another home. So you should look at Mars, the second planet can be Pluto. Hawking was confident that humanity would learn to fly to these planets in about an hour or one day.



Photo 1 – Stephen Hawking

Stephen Hawking's fame was founded on the research he did on general relativity and black holes. But he often stepped outside his own field of research, using his recognition to highlight what he saw as the great challenges and existential threats for humanity in coming decades. His pronouncements drove headlines in the media, which sometimes proved controversial [1].

Stephen Hawking warned about artificial intelligence. He said that there is a risk that in the near future there will be a “rebellion of machines”, Artificial intelligence will be able to destroy people. Physicist said that humanity has passed the point of no return, as the machines will become smarter than humans

"Artificial intelligence will be the most terrible event in the history of our civilization. This will be another danger on the planet along with nuclear and nuclear weapons, so we need to calculate all the risks"— he said.

Stephen Hawking believed that in our Universe, we are not alone, but warned that contact with foreign intelligence can lead to disaster. A meeting with the aliens he compared how native Americans met Christopher Columbus and warned about the consequences.

Hawking said the primitive forms of artificial intelligence developed so far had already proved very useful; indeed, the tech he used to

communicate incorporated a basic form of AI. But Hawking feared the consequences of advanced forms of machine intelligence that could match or surpass humans [1].

Besides, he talked about the fact that scientists have received a signal from planet Gliese 832c, but this information is not spread, and the answer decided to wait. This message was not in an alien language, but in the form of a heap of physico-mathematical formulas.

Although almost all scientists say that time travel is heresy, Stephen Hawking was sure that there will come a time when people will learn to move in it. As a time machine can be a black hole and time faults and strings in space.

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**Аннотация.** Автор излагает некоторые факты о Стивене Хокинге – английском физике-теоретике. Перечислены предсказания Стивена Хокинга. Статья посвящена великому физику и неординарному человеку.

**Ключевые слова:** Стивен Хокинг, физик, предупреждения, человечество, предсказание.

**Summary.** The author states some facts about Stephen Hawking's life – an English theoretical physicist, cosmologist and author. Stephen Hawking's predictions are listed. The article is devoted to the great physicist and extraordinary man.

**Keywords:** Stephen Hawking, physicist, warnings, humanity, predict.

UDC 58.08

## NEUTRINO. NEUTRINO COMMUNICATION

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Neutrino-quantum of neutral radiation, a neutral fundamental particle with a small mass, spin  $\frac{1}{2} \hbar$ . It is a particle that can only be affected by gravity and weak nuclear interaction. It is very similar to an electron, but has no electric charge. This is one of the most common particles in the Universe.

Neutrino has phenomenal penetrating power. Hans Bethe and Rudolf

Peierls in 1934 calculated with the help of the theory of Fermi that neutrinos with energies of the order of a few MeV interact with matter is so weak that it can easily overcome the liquid hydrogen layer with a thickness of a thousand light-years. Learning about this, Paulie during a visit to California technology said that he had done a terrible thing — predicted the existence of particles that are impossible to detect. And it's really fantastic-it flies through the Earth, the Sun, any celestial body without any constraints. This property alone makes the research of the particle very demanded.

### **Prospects and problems in the research of neutrinos**

Neutrinos arise as a result of thermonuclear reactions. They can travel for many light-years to interact with the substance. For example, in one second, every square centimeter of our body is pierced by about 60 000 000 neutrinos that the Sun sends to us, but nevertheless, we do not feel them. So one of the problems in the study of neutrinos is the difficulty of their elementary "catching". It is necessary to pass a million billion neutrinos through the kilometer thickness of the solid, so that at least one of them could cause any effect.

Academician M. Markov, a specialist in neutrino physics, wrote about this particle: "it is difficult for a Contemporary to guess what true place neutrinos will take in the physics of the future. But the properties of this particle are so elementary and peculiar that it is natural to think that nature has created neutrinos with some deep, while for us is not always clear "purposes".

To this day, this particle is not fully studied, but scientists have identified some promising areas where its unique properties can be used:

1. Neutrino astronomy. This section of astronomy studies neutrino radiation from sources outside the solar system. The results of these studies shed light on the ongoing space processes. All stars emit not only light, but also the neutrino fluxes arising as a result of nuclear reactions. Late stages of star evolution are characterized by a large loss of neutrinos (up to 90%), resulting in neutrino "cooling". Since neutrino fluxes without any absorption are able to travel huge distances, it is possible to study the properties of very distant objects.

2. Diagnostics of course of nuclear reaction. This diagnostics is applicable to industrial nuclear reactors and nuclear power plants. This direction is very perspective, and many countries conduct works on production of special detectors. They have to measure the power of the reactor and composite composition of fuel in real time by means of measurement of a neutrino range of the reactor.

3. Communication on the basis of neutrino flows. It will do possible data transfer in any points of earth space, underground and underwater.

Very important advantage — information transfer through thickness of the planet and on ultralong distances without loss signal powers.

4. Geology. Those neutrinos that were formed after the radioactive decay of elements inside the Earth can help in the study of the internal composition of the planet. If you measure the intensity of the neutrino flux in different parts of the world, the drawing up of maps, which will display the sources of radioactive heat generation.

### **Means of communication based on neutrino fluxes**

Radio communication is common everywhere, but there are cases when it is not applicable. For example, if a spacecraft is hidden behind a Moon or planet, radio communication is usually interrupted by interference. Submarines often lose radio communication in deep water, because only ultra-low-frequency waves are able to penetrate through the water. Even in this case, the data transfer rate is 1 bit per minute.

In 2009, Paul Huber, a physicist at Virginia Polytechnic University, suggested that the use of neutrino fluxes to communicate with submarines would overcome these problems and provide data transmission at speeds up to 100 bits per second.

And on March 14, 2012, there was an event comparable to the invention of radio communication: scientists from the American national accelerator laboratory named Enrico Fermi (FermiLab) were able to transmit information using neutrino particles. So far, this is the first complex experiment far from practical using. But now there is confidence that the development of neutrino communication technology will revolutionize communications and radically change the world.

A huge stream of neutrinos constantly permeates our planet. But to catch such a particle is a rather nontrivial task. For this purpose, substances scintillators: isotopes of chromium, potassium or others as a result of the interaction of particles and scintillator there is a special radiation. It is this radiation that is detected by the Minerva detector photodetectors. NuMi injector is used as a source, which emits protons with energy of 120 GeV.

During the experiment, the injector and receiver were located opposite each other at the distance of 1035 meters (the detector was located underground, at a depth of more than a hundred meters). It managed to transmit the data set length to 156-bits, which encoded the word «neutrino».

Of course, the practical application of this technology is still far. The data transfer rate is only 0.1 bits per second, which is far from ideal – up to 100 MB per second. The principal possibility of this type of communication has yet to be proved. Its practical implementation requires much more powerful transmitters and detectors. But nanotechnology promises great prospects in this direction. The development of technologies using neutrinos



will open up new opportunities in the development of communication systems.

### **Conclusion**

Taking into account the penetrating ability of neutrinos and other properties, it is relevant and possible to further develop communication tools based on neutrino fluxes. This opens up limitless possibilities for the transmission of information both to various points of the globe and beyond. The future of the information society depends on neutrino communication.

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UDC 53.043

### **NANOSTRUCTURES PROMISE ICEPROOF SURFACES: SUPERHYDROPHOBIC ONES**

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In recent years, the strategy to prepare superhydrophobic surfaces with water contact angles higher than  $150^{\circ}$  is innovative because of their potential applications in self-cleaning, metal refining, adhesion preventing and drag reduction in fluid flow [1]. Superhydrophobic surfaces were studied by R. Blossey, A. Nakajima, K. Hashimoto, T. Watanabe, K Takai, G. Yamauchi, A. Fujishima, H.Y. Erbil, A.L. Demirel, Y. Avci, O. Mert and others. Superhydrophobic surface of aligned polyacrylonitrile nanofibers was considered by L. Feng, S. Li, H. Li, J. Zhai, Y. Song, L. Jiang, D. Zhu.

F. Shi, Z. Wang, X. Zhang deal with combining a layer-by-layer

assembling technique with electrochemical deposition of gold aggregates to mimic the legs of water striders” “Remarkable achievements have been recently made in superhydrophobic surfaces with tailoring the surface topography and using techniques such as anodic oxidation, template extrusion, the electrodeposition and/or chemical etching, plasma etching, laser treatment, electrospinning and chemical vapor deposition” [1, www].

Frost and ice are two things you'd certainly expect to find in a freezer, but in some cases they can present huge problems. Ice is a good insulator, “which means that an object placed in a frost-encrusted freezer will get cold at a much slower rate than it would if the walls were bare metal” [2, www]. Water vapor dissolved in the air can condense on cold surfaces, like breath fogging up a window in wintertime. When the tiny droplets of water in that fog freeze, it can build up into a frost coating that ruins the freezer's efficiency [2].

One of the most popular methods to solve this problem has involved using superhydrophobic (water repellent) surfaces; if the surface can prevent water from forming on it, the logic goes that it might be able to prevent icing as well. Superhydrophobic is hydrophobic surface having nano-scale roughness.

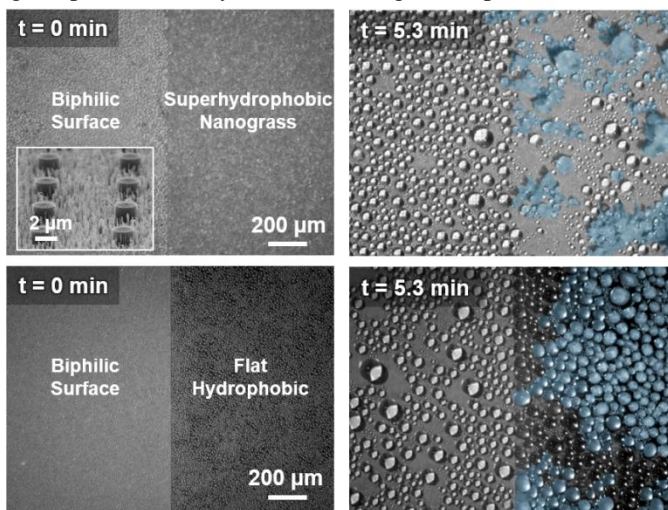
Nano-roughness creates superhydrophobic surfaces. Water perched on hydrophobic posts containing trapped air. High contact angle water air hydrophobic posts nano-roughened surface. Two essential features are generally required for superhydrophobicity: a micro- or nanostructured surface texture and a nonpolar surface chemistry, to help trap a thin air layer that reduces attractive interactions between the solid surface and the liquid.

For water droplets to roll off of something, they have to grow and the force of gravity overcomes their adhesion to the surface. Superhydrophobic surfaces work to reduce that adhesion, but the droplets that form a condensation "fog" are extremely tiny, so they freeze easily before reaching a large enough size to roll off [2].

There's another way for droplets to leave a surface, though—they can jump! When two droplets grow large enough to touch and join together, the force of this coalescence can propel them off the surface. This interesting phenomenon has stimulated extensive research to make artificial superhydrophobic surfaces and to employ them for a variety of applications. A key challenge in making superhydrophobic surfaces is to tailor the morphology of the surfaces in nanometer scales, which typically involves synthesis and fabrication of materials at nanometer dimensions.

By interspersing tiny hydrophilic (water-attracting) “pillars” among the nano-grass of a superhydrophobic surface, as shown in the top-left inset image, it's possible to create spots where the droplets will grow large

enough to “jump” off before freezing. By taking advantage of these jumping-off points, we may be able to design frost-proof surfaces (Pict.1).



**Picture 1 – Frost Formation Stopped Cold**

Surfaces with superhydrophobic characteristics are of considerable current interest owing to their potential utility in solving key technological problems. Superhydrophobic surfaces possess self-cleaning characteristics due to their unique surface texture and chemistry, which control wettability. The surface micro/nano texturing combined with low surface energy of materials lead to enhance anti-wetting properties.

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**Аннотация.** В данной статье автор рассматривает исторические и современные исследования супергидрофобных поверхностей, в том числе характеристику супергидрофобности, различные способы их применения.

**Ключевые слова:** супергидрофобные поверхности, наномасштаб, смачивание.

**Summary.** In this article, the author reviews the historical and present research on superhydrophobic surfaces, including the characterization of superhydrophobicity, different ways of their application.

**Keywords:** superhydrophobic surfaces, nano-scale, wettability.

UDC 577.1

## **INFLUENCE OF SOLAR ACTIVITY ON THE HUMAN BODY**

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The Sun is a source of energy that is necessary for life on the Earth, but solar activity is not constant. The manifestation of activity is due to the fact that the solar plasma has magnetic properties; as a result active regions appear on the Sun, which distinguish as solar flares, floccus, spots, flashes, prominences, etc. In a well-developed active region an explosion of a small volume of solar plasma sometimes occurs suddenly. This is the most powerful manifestation of solar activity called as the solar flare. It arises in the region of the change in the polarity of the magnetic field, where strong oppositely directed magnetic fields "collide" in a small region of space, as a result of which their structure significantly changes. Usually a solar flare is characterized by rapid growth (up to ten minutes) and a slow decline (20-100 min.). During a flare, the radiation increases practically in all ranges of the electromagnetic spectrum. Solar flares, depending on the brightness of the X-rays produced by them, are divided into five classes: A, B, C, M, X. The flash of class M is 10 times weaker than X, class C is 10 times weaker than M, etc. Such activity of the Sun can cause magnetic storms on Earth [1, p. 3-11]. A geomagnetic storm is a disturbance of a geomagnetic field lasting from several hours to several days, the annular current of the Earth is

increasing, which constantly exists in the region of the Earth's radiation belts [2, p. 5-35].

The micronuclear test is based on taking into account micronuclei in different populations of dividing cells. The micronuclear test is a generally accepted cytogenetic method for evaluating the mutagenic action of agents of different nature. Micronuclei are acentric chromosome fragments and individual whole chromosomes lost during mitosis. The micronucleus is a chromatin body of round or oval shape with a smooth continuous edge, not larger than 1/3 of the nuclei. It does not refract light and has the intensity of coloring and chromatin pattern, as in the nucleus, and is in the same plane as the nucleus. The indicator of genetic disorders may be a separate number of protrusions observed in interphase nuclei, as well as karyolysis, karyorrhexis and karyopycnosis are anomalies associated with the destruction of the cell nucleus. Protrusion very similar to micronuclei can be formed fragments of chromosomes or separated attachment of the spindle of fission by whole chromosomes, the nuclear envelope around which is connected to the shell of the main nucleus [3, p. 287-292].

The purpose of this work was to determine the number of disturbance in cells of the buccal epithelium of a human as the effect of solar flares causing magnetic storms on Earth.

Materials and methods. The researches were carried out during the period of the effect of a solar flare of Class C ( $10^{-6}$ - $10^{-5}$  W/m<sup>2</sup>) on the Earth's magnetic field, as a result of which magnetic storms were observed. To estimate the intensity of the solar flare, data from GOES Xray Flux (NOAA / SWPC Boulder) was used. The experiments were carried out on short-term culture of human buccal epithelium cells. Samples of buccal epithelium cells were taken from 3 donors (A, B, C) male on the third, seventh and tenth day after the outbreak, the last day is control. All donors are healthy and nonsmoking. All samples with cells were stained with a 0.76% solution of Giemsa's azur-eosin-methylene blue in a mixture of methanol and glycerin (1:1) for 10 min. The cells were visually examined under the microscope MICROMed XS-3330 with a magnification of 400.

The experiment consisted of the following stages:

1. To assess the effect of solar flare activity on the human body.
2. Conduct a comparative analysis of the number and nature of disorders in buccal epithelial cells that arise after solar activity with the normal state of the human body.

The results of the study on the effect of a Class C solar flare on the cells of the buccal epithelium of donors-A, B, C are presented in the Table 1 and in the Figure 1 where the change in the number of disturbances as the flare affects is also depicted.

Table 1. The number of various disorders observed in cells of the buccal epithelium of donors under the influence of a solar flare of class C

Infringement/ Donors	1st day			7th day			10th day		
	A	B	C	A	B	C	A	B	C
Micronuclei	5	17	3	7	5	0	2	1	2
Notching	2	1	1	3	2	1	2	2	1
Protrusion of the "Language" type	1	0	0	3	1	0	2	1	0
Protrusion type "Broken egg"	2	1	4	1	1	0	1	0	0
Carinolysis	0	0	10	0	1	12	1	1	14
Karyorexis	0	0	5	2	1	9	0	1	5
Karyopcnosis	9	4	2	11	10	7	6	2	3
2-core	1	8	0	4	5	3	2	3	1
Total number of violations	20	31	25	31	26	32	16	11	26
Total number of cells scanned	1539	1519	1907	1625	1577	1516	1543	1522	1513

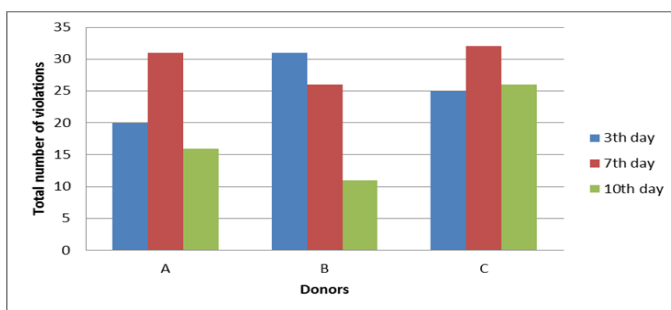


Figure 1 - Influence of a solar flare of class C on cells of buccal epithelium of donors A, B, C

Analysis of the results showed that a solar flare of class C ( $10^{-6}$ - $10^{-5}$  W/m<sup>2</sup>) affects the total number of disorders in the cells of the buccal epithelium in comparison with the control (10th day). However, there are differences in the number of disorders in the third and the seventh day of collection, which can be explained by the peculiarity of the individual reaction of the organism of each donor. From Table 1 it follows that for donors A and B, the effect of solar activity was manifested in an increase in the number of micronuclei on the third and seventh day, donor protrusions of the type "broken egg" and karyopcnosis associated with cell disruption were observed in donor C.

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**Аннотация.** В статье изучается влияние солнечных вспышек на организм человека. Исследование проводилось на клетках буккального эпителия человека с помощью оптической микроскопии. Для оценки влияния использовался микроядерный тест. Анализ результатов показал, что солнечная вспышка оказывает влияние на общее количество нарушений в клетках буккального эпителия человека в сравнении с контрольным образцом, при этом наибольшие изменения наблюдались по нарушениям: микроядра, протрузии.

**Ключевые слова:** активность Солнца, солнечная вспышка, микроядерный тест, буккальный эпителий, микроядра, протрузия.

**Summary.** The article studies the effect of solar flares on the human body. The study is carried out on human buccal epithelial cells using optical microscopy. To assess the effect, a micronuclei test is used. Analysis of the results show that the solar flare affects the total number of disorders in the cells of the buccal epithelium of the human body in comparison with the control sample, with the greatest changes observed in the disorders: microkernels, protrusions.

**Keywords:** solar activity, solar flare, micronuclei test, buccal epithelium, micronucleus, protrusion.

UDC 54/664

## **DETERMINATION OF PHYSICO-CHEMICAL PARAMETERS OF COOKED SAUSAGES**

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A sausage is a cylindrical meat product usually made from ground meat, often pork, beef, or veal, along with salt, spices and other flavourings, and breadcrumbs, encased by a skin. Typically, a sausage is formed in a casing traditionally made from intestine, but sometimes from synthetic

materials.

The word "sausage" was first used in English in the mid-15th century, spelled "sawsyge". This word came "...from Old North French saussiche (Modern French saucisse)". The French word "saussiche" came "...from Vulgar Latin "salsica" "sausage," from salsicus "seasoned with salt," from Latin salsus meaning "salted" [1].

The purpose of our paper is determination of correspondence of the quality parameters of cooked sausages to normative documents.

Sausages presented in the supermarkets of Kerch were selected as the object of the research in this work:

1. Sausage "Liubitelskaya" (Skvortsovo).
2. Sausage "Doctorskaya" (Skvortsovo).
3. Sausage "Viazanka".
4. Sausage "Lubitelskaya" (Krasnodar).
5. "Vetchina po-kupecheski" (Skvortsovo).
6. Sausage "Venskaya polukopchenaya".

The following physical and chemical parameters as content of nitrites, starch, salt and common phosphorus were determined in the samples.

Sodium nitrite ( $\text{NaNO}_2$ ) E-250 is a fixator of myoglobin, it provides a stable pink colour of meat, sausages and pork. Sodium nitrite is added to some delicious canned meat, as well as to the salting mixture in order to preserve the "natural" red-pink colour of these products. In addition, sodium nitrite is used in the production of cheese to prevent its early swelling.

Sodium nitrite, reacting with the pigments of the meat (myoglobin), forms a red substance – nitrosohematoglobulin, turning at the heat treatment into hemochromogen, which gives the sausages persistent pink-red colour.

However, the nitrites have a high toxicity in comparison with nitrates, used for the same purpose, therefore, it requires strict dosing and uniform distribution of nitrite in ground beef, as well as control over solution preparation, its introduction into the meat and storage time.

The maximum permissible concentration of nitrite in sausage meat is 50 mg/kg.

The toxicity of nitrites depends on the amount of methaemoglobin. Accumulation of methaemoglobin in the blood can lead to varying degrees of hypoxia. In addition, nitrites have an inhibitory effect on digestive enzymes, in particular pancreatic lipase and alkaline phosphatase. A single injection of 100-150 mg of nitrites causes redness of the face skin, lowers blood pressure, increases pulse, sensation of noise in the head. With the introduction of 300 mg, there is abundant sweating, blueness of the skin, shortness of breath, dizziness, visual impairment. There were severe intoxication with various sausages containing large concentrations of



nitrites – from 200 to 6570 mg/kg of the product. There are described some cases of nitrite methaemoglobinemia by eating fish treated with nitrite of sodium. The permissible daily intake of sodium nitrite is 0.2 mg/kg body weight or 0.15 mg / kg per nitrite ion.

The subject matter of the method of determination of nitrite content in samples of sausages is extracting of milled samples with hot water, followed by protein precipitation and filtration. Obtaining a red colour in the presence of nitrite is achieved by adding sulphanilamide and N-1-naphthylethylenediamine hydrochloride (Griess reagent) to the filtrate followed by photometric measurement at a wavelength of 540 nm on a photoelectric calorimeter of brand KFK-2.

In the production of certain food products for technological reasons improvers of texture, which keep the texture of the product permanent are widely used substances. Texture improvers are mainly used in the production of food products with unstable texture and unhomogeneous structure. Such products as, for example, ice cream or marmalade, cheeses or sausages when containing these food additives acquire new, qualitatively higher criteria. Many of the substances used as emulsifiers and stabilizers are food components or are obtained from plants, and therefore they are comparatively harmless to humans.

One of the most popular compounds having the properties of thickener and gelling agent is starch and its derivatives - modifying starches.

Starch belongs to the group of high-molecular polyose unlike sugar. The starch molecules built up from a large number (6 to 10 thousand) of residues of simple sugars (monosaccharides or mannose). Starch is a mixture of two types of polymers, built up from the residues of glucopyranose: amylose and amylopectin. The composition of starch depends on its physico-chemical properties.

Amylose is a linear polymer, its molecule contains from 1000 to 6000 glucose residues, and the molecular weight ranges from 16000 to 1000000.

Amylopectin contains 5000-6000 glucose residues, molecular weight can reach, as in amylose, 1000000.

Recently modified starches have been widely used in the food industry. Their properties differ from properties of conventional starch, according to the degree of hydrophilicity, ability to cluster and gel as a result of various effects (physical, chemical, biological).

Single- and multiple-treated starches do not significantly differ in their biological effects on the body. These substances in moderate amounts are well absorbed, without having a negative effect on the functions of organs and systems. However, if their content in the food exceeds 10%, they cause diarrhoea and dilation of the blind gut. Therefore, only enzymatically

processed starches are recommended to use without restriction.

At the increased content of starch in sausages there is a souring due to the presence of bacteria – potato sticks. The norm of starch according to the normative document is 2%.

The subject matter of the method for determining starch is heating the control sample in a solution of potassium hydroxide and ethyl alcohol until the complete dissolution of the constituent parts of the meat, followed by draining, washing of the remaining sludge with heated ethyl alcohol, filtration, dissolution in hydrochloric acid and hydrolysis. Titrimetric determination of glucose formed by sodium thiosulfate in the presence of an indicator is the final stage of this method.

Salt or sodium chloride NaCl belongs to the group of food additives that improve the taste of food products, i.e. flavoring substances. In addition, salt is widely used as a preservative for food products in the preparation of fish, vegetables, meat, mushrooms and many other products.

However, the use of salt is not limited by its use as a food additive. Sodium chloride plays an important role in maintaining water-salt metabolism in the body. It is known that insufficient intake of sodium chloride leads to severe disorders of water-salt metabolism, functional and organic disorders. Due to sodium chloride, the intake of basic quantities of sodium and chlorine is provided to organism. Its physiological significance is extremely diverse. Sodium chloride is necessary to maintain the acid-base balance in the body, as well as to ensure the stability of osmotic pressure in the blood plasma. The source of chlorine for hydrochloric acid, as one of the most important components of gastric juice, is also sodium chloride.

The body's need for sodium chloride for an adult in a temperate climate is 10-15 g per day. In a hot climate, this dose increases to 25 g per day. The daily requirement is usually met by the natural content of sodium chloride in food products (about 2-5 g) and the addition of salt into food (7-10 g).

High quality salt should contain at least 99.2 – 96.5% of the base material, the salt content of impurities of any toxic compounds of metals, nitrates and nitrites is not allowed. The mass fraction of sodium chloride in sausages is not more than 2.5 %.

The analysis of sausages for the content of sodium chloride was carried out by argentometric titration using the method of Mora in the presence of potassium chromate indicator.

Diphosphates, pyrophosphates-E-450 are a food additive acting as an emulsifier, stabilizer, acidity regulator, dispersing agent and leavening agent, complexing agent and water retaining agent.

A group of diphosphates (pyrophosphates) consists of pyrophosphates

- disodium, trisodium, tetrasodium; pyrophosphates – dipotassium, tripotassium, tetrapotassium; pyrophosphate dicalcic. Sodium pyrophosphate trisubstituted monohydrate is used in the production of processed cheese, sausages and other products. All diphosphates are allowed to be used, with the exception of dimagnesium pyrophosphate (E450 (viii)), which is approved for use in our country, but not used abroad.

Obtained results. As it can be seen from the presented data, the content of starch in sausages "Vetchina po-kupecheski" and "Venskaya polukopchenaya" meet the requirements of normative documentation. So does the content of nitrites in sausage "Lubitelskaya" ("Skvortsovo"). The salt content is overestimated in all product samples, the content of total phosphorus is the lowest value in the sample of sausage "Lubitelskaya" ("Skvortsovo").

Thus, as a result of the carried-out work the analysis of the received data on compliance to the existing normative document is carried out with the help of determination of physico-chemical indicators of quality of 6 types of sausages. According to preliminary data, the content of nitrites and salt in sausage "Lubitelskaya" ("Skvortsovo") meets the requirements of the state standard GOST R 52196-2011 cooked sausages. Technical conditions.

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Таблица витаминов и микроэлементов (дневная норма, витамины в продуктах) URL: <http://www.vitamarg.com/health/article/608-tablica-vitaminov-microelementov>

**Аннотация.** Цель данной работы – определение соответствий показателей качества варенных колбас нормативным документам.

**Ключевые слова:** колбаса, нитрит натрия, крахмал, хлористый натрий, дифосфаты и пирофосфаты.

**Summary.** The purpose of our paper is determination of correspondence of the quality parameters of cooked sausages to normative documents.

**Keywords:** sausage, sodium nitrite, starch, sodium chlorine, diphosphates and pyrophosphates.

**THE DEFINITION OF EFFICIENCY PHOTOBIOSYNTHESIS AT  
DIFFERENT DENSITIES OF THE SPIRULINA PLATENSIS  
CULTURE**

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Light is the main factor of the environment, which determines the growth rate of microalgae. A great amount of researches are devoted to the study of the irradiation effect on the rate of photobiosynthesis, whereby photobiosynthesis should be revealed as the coordinated synthesis of all components of the organism, i.e. biological synthesis of living structure. However, an important parameter is the efficiency of utilization of light energy. This value can be expressed through the photobiosynthesis efficiency [4]. Despite the fact that studies of the dependence of the efficiency of microalgae photobiosynthesis were started 1970s [2], it has not been determined until now where most of the energy stored in photosynthesis is lost. The magnitude of photobiosynthesis efficiency is determined by the amount of energy absorbed by the cells, which are the spectral characteristics of the microalgae culture and also by the increase in biomass taking into account its caloric value.

The article's topicality is connected to the current studies of the dependence of photobiosynthetic efficiency on external environmental conditions which will provide new knowledge about the internal organization of biosynthetic processes occurring in microalgae cells. In addition, knowledge of photobiosynthesis efficiency will make it possible to give recommendations on the selection of light energy sources in order to optimize the process of microalgae cultivation and to organize industrial

microalgae production too [5]. The **aim** of the work is to determine the photobiosynthesis efficiency at various densities of microalgae culture.

**Material and methods.** As the object of the study was chosen as *Spirulina* (*Arthrospira*) *platensis*, obtained from the collection of the Institute of Marine Biological Research under the name of A.O. Kovalevskiy. *S. platensis* was grown in the unified laboratory on Zarruk nutrient medium [6]. The temperature was maintained at  $25 \pm 0.5$  °C. The illumination of the photobioreactor surface was 6.5 kl.

During the experiment, the temperature, the optical density of the microalgae culture and dry biomass were measured. Before sampling, the volume in the photobioreactor was adjusted with some distilled water to the initial one, compensating the evaporation. The temperature of the suspension in the photobioreactor was measured by a mercury thermometer; the absolute error of the measurements was 0.5°C. Illumination of the photobioreactor surface was determined by the lux meter U-116. Sampling for determining the optical density was carried out from different points inside the photobioreactor: 5 ml of a suspension of algal cells were selected, thus obtaining an "average sample" of 30 ml volume. In the average sample, after mixing the transmittance was determined.

The optical density was calculated by the formula:  $D = -\lg(T)$ , where T is the transmission value determined by the photometer CPC-2 (Colorimetric photovoltaic concentrator) at a wavelength of 750 nm, the error in measuring the transmittance did not exceed 1%. When the units of optical density were converted to dry biomass, an empirical coefficient of 0.88 was used. The measurements were made with respect to the distilled water. The cuvettes were placed as close as possible to the photodetector, which made it possible to reduce the measurement error of the optical density of the culture associated with light scattering. When the instrument reads beyond the limits of the operating range (from 30 to 70% of the transmission), the sample was diluted with distilled water. A two-beam spectrophotometer UNICO-4802 was used to determine the absorption spectrum of the culture. To determine the emission spectrum of a light source consisting of 10 fluorescent lamps, an X-rite ColorMunki Photo spectrophotometer with a working range of 380 nm to 730 nm was used.

**Results and discussion.** By definition, photobiosynthesis efficiency is a ratio of two quantities: stored ( $E_x$ ) and absorbed light energy ( $E_n$ ):

$$\eta = \frac{E_x}{E_n} \cdot 100\%$$

The absorbed energy depends on the amount of energy incident on the photobioreactor surface ( $E_0$ ), surface area ( $S$ ), time and energy absorption coefficient for microalgae ( $\alpha$ ) cells:  $E_n = E_0 \cdot S \cdot t \cdot \alpha$ .

The value of Ex is determined by the product of the increase in the biomass and its caloric value R, i.e.

$$E_x = R \cdot P \cdot V,$$

where P is the productivity or the absolute growth rate, g / (l day), where the mass of dry matter is measured in grams (biomass); V is the working volume of culture, l.

Consequently, the expression for determining the photobiosynthetic efficiency can be represented as:

$$\eta = \frac{R \cdot P \cdot V}{E_0 \cdot S \cdot t \cdot \alpha}.$$

To determine the amount of absorbed light energy, we use the Bouguer-Lambert-Beer law which is represented as:

$$I = I_0 \cdot 10^{-D}, \frac{I}{I_0} = 10^{-D}, -\lg(T) = D \cdot$$

Light absorption coefficient  $\alpha$  for the corresponding light wave:

$$\alpha = \frac{I_0 - I}{I_0} = 1 - T.$$

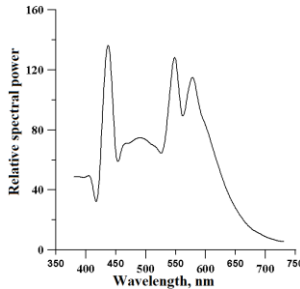


Figure 1 – The emission spectrum of fluorescent lamps TDM Electric 18 watt used in the experiment

The Bouguer-Lambert-Beer law is not always applicable to the calculation of the absorption coefficient due to the high heterogeneity of microalgae cultures [7]. However, for small cell concentrations the dependence of the optical density of culture on biomass is described quite accurately by a linear equation.

For different wavelengths of the light flux the value of  $\alpha$  differs, and it can be determined from the spectrum of the culture. To calculate the energy, absorption coefficient  $a_{sp}$ ,  $a$  is multiplied by the fraction of the energy of the lamps  $\delta$  assigned to each wavelength. In the experiment we use fluorescent lamps, the spectrum of which is shown in Figure 1. To find  $\delta$ , we divide the values of the relative spectral power by their total value.

To find the light absorption coefficient  $a$ , the culture of *S. platensis*

recorded its absorption spectra at different densities, which were stabilized in a semiproduct mode of cultivation. The curve of spirulina growth is shown in Figure 2.

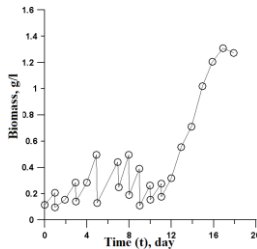


Figure 2 – The growth curve of the *S. platensis* culture in the experiment

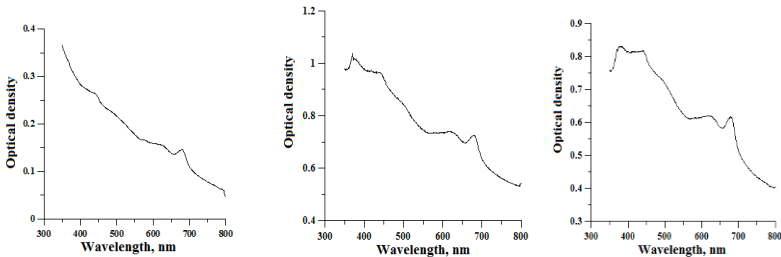


Figure 3 – Spectra of absorption of *S. platensis* culture at various densities

It is necessary to summarize the obtained values of  $a_{sp}$  in the region of the PAR (Photosynthetic Active Radiation) to obtain the integral energy absorption coefficient. For a culture density of 0.16 g / l -  $a_{sp} = 0.6$ ; for a density of 0.32 g / l -  $a_{sp} = 0.95$ ; for a density of 0.39 g / l -  $a_{sp} = 0.97$ . The obtained values indicate that at a density of more than 0.4 g of CB / liter, practically all of the energy incident on the surface of the culture is absorbed, i.e.  $a_{sp} = 1$ . Note that in this case the culture passes into the phase of linear growth, the maximum productivity was 0.23 g / (l day).

To determine the amount of absorbed energy, we translate the photometric units of illumination into units of energy quantity. For this we use the

relation [1]:  $E_0 = 1,464 \cdot 10^{-3} \cdot N \cdot E_v$ , where  $E$  is the irradiance, W / m<sup>2</sup>;  $E_v$  is the illumination of the surface, lk, and  $N$  is the ratio of the values of the total energy and the light energy determined by the luminometer. For the lamps used, taking into account this spectrum (Figure 1), the value of  $N$  is 2.29. Thus, the surface will fall:

$$E_0 = 1,464 \cdot 10^{-3} \cdot 2,29 \cdot 6500 = 21,79 \text{ W/m}^2.$$

Since the surface area of the photobioreactor in the experiment was  $0.05 \text{ m}^2$ , about 1.09 W of the PAR falls to the surface of the culture.

To find the energy stored in the biomass, we determine the productivity of the *S. platensis* culture for the three above densities: for 0.16 g / l it is  $P = 0.063 \text{ g} / (\text{l day})$ , for 0.32 g / l, it is  $P = 0.15 \text{ g} / (\text{l day})$  and 0.39 g / l, it is  $P = 0.21 \text{ g} / (\text{l day})$ .

The average calorific value of 1 g of biomass of *S. platensis*, like many other microalgae, is about 5 kcal or 20.86 kJ [3]. Note that the calorific value of biomass is determined by its biochemical composition (the ratio of proteins, fats and carbohydrates), which can vary widely and be determined by the conditions of cultivation [8]. With further calculations, we will use the indicated average caloric value.

Thus, we can calculate the efficiency of photobiosynthesis for different densities of *S. platensis*. The results are shown in Table 1.

Table 1. Values of photobiosynthesis efficiency, energy absorption coefficient and productivity for different densities of *S. platensis* culture

Density of culture, B, g/l	Absorption coefficient, $a_{sp}$	Productivity, g / (l·day)	Photobiosynthetic efficiency, %
0,16	0,6	0,063	2,32
0,32	0,95	0,15	3,50
0,39	0,97	0,21	4,79
0,4<B<1	1	0,23	5,09

The obtained results indicate that the photobiosynthesis efficiency increases with the growth of the culture density. Similar conclusions are confirmed by the literature data [2]: While increasing the culture density, the amount of light energy incident on the cell decreases, which leads to the growth of its utilization efficiency. According to the published data [2, 5], this value reaches 11-15%.

It should be noted that calculating the efficiency, the caloric content of the biomass is considered to be unchanged; under real conditions this value changes due to developments of the biochemical composition of the microalgae cells. Moreover, determining the energy absorption coefficient, the microalgae culture spectrum must be recorded with the instrument with integrating sphere, which avoids the errors associated with the scattering of light.

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**Аннотация.** В работе получен КПД фотобиосинтеза при разных плотностях культуры *Spirulina platensis*. По спектру поглощения культуры и спектру излучения световой решетки рассчитаны коэффициенты поглощения энергии. Показано, что КПД фотобиосинтеза увеличивается с ростом плотности культуры, достигая максимального значения 5,09 % на линейном участке. Недостатком проведенных расчетов является априорное постоянное значение калорийности биомассы.

**Ключевые слова:** закон Бугера-Ламберта-Бера, коэффициент поглощения энергии, калорийность биомассы.

**Summary.** The article is devoted to the determination of photobiosynthetic efficiency at different densities of *Spirulina platensis* culture. The energy absorption coefficients are calculated on the base of the absorption spectrum of the culture and the emission spectrum of the light grid. It is shown that the photobiosynthesis efficiency increases with the growth of the culture density, reaching a maximum value of 5.09% in the linear section. The main disadvantage of given calculations is the a priori constant value of the calorific value of the biomass.

**Keywords:** Buger-Lambert-Beer law, energy absorption coefficient, caloric value of biomass.

## SECTION 7: LAW.



UDC 340.113.2

### **INNOVATIONS IN LAW: AN OVERVIEW OF ACHIEVEMENTS AND TRENDS IT-TECHNOLOGIZATION OF LAW BUSINESS IN JURISDICTIONS**

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The sphere of legal services is one of the most unselfish by innovative influence. Nevertheless, fundamental changes in the sphere of communications, the growth of globalization processes, the continuous development of information technologies are changing the economic situation of the market, forcing organizations engaged in the provision of commercial services in the field of law to meet the requirements of the time [2]. Considering innovations in the field of legal services and legal assistance, one should not miss innovations in the judicial system of the Russian Federation. It can be noted that since the beginning of 2017, a new procedure for filing documents in electronic form was approved by the Supreme Court of the Russian Federation [3].

Today there are IT-products for all 4 main types of clients of the lawyer: physical person, small business, corporations and law firms. It is possible to allocate at least 6 variants: online services offering generic solutions for legal issues that can be standardized (<https://www.legalzoom.com>); online search for lawyers, i.e. mediation in the process of mixing the client with the customer (for

example, <https://www.lexoo.co.uk> <https://lawkick.com>); E-discovery services to find data for lawyers (<https://lexmachina.com>, <http://www.axiomlaw.com>, <http://ravellaw.com/>); project management in law firms ([www.accelo.com](http://www.accelo.com)); notarial services-performing simple notarial actions (service <https://notarize.com/>); Automation consideration of in-doubt transactions, create claims (<http://modria.com>).

United States was a pioneer in the implementation of solutions legal tech, where in the early 2000s startups, actively implementing information technology in solving legal problems began to appear. Among the first companies one can name Rocket Lawyer and LegalZoom, providing services for the creation of dynamic documents, smart contracts and legal advice

According an analogy with Fintech an increasingly expanding sector of creation, testing and introduction of financial products into commercial practice using IT-technologies providing total virtualization of financial services and "internetization" of processes of interaction between their providers and clients, the legal world of the USA, great Britain, Canada, Australia and all other developed countries of the English - speaking world develop Jurtech (Legaltech or Lawtech)-the field of application of IT-technologies in juridical services market.

Here are the main characteristics of this new direction of the overall competitive race:

- providing customers the ability to remote access around the clock to communicate with their lawyers, to order and receive the necessary services and pay for them, creating Internet portals to provide legal services;
- translation of documents, protection of correspondence and databases from illegal invasion, loss, corruption of files, false (fake) documents;
- support of electronic interaction with all domestic judicial institutions, administrative bodies, governing bodies and conflict resolution bodies of professional self-regulatory organizations, with ombudsmen, as well as with bodies of the European Union as all these institutions and bodies introduce electronic systems of public services provision and interaction with society;
- equipment of legal practices with specialized legal search robots and chatbots and its own unique development, which should emphasize the status of the company;
- application of software methods of analysis of electronic files of legal documents (*predictive coding*) for the purpose of worthy participation in procedures of disclosure of information (*discovery*, *disclosure*) in connection with judicial representation, as well as for protection of clients '

interests in administrative bodies. Create integrator for the arch at one point legal IT-startups, investors and consumers of new software products, creating and sustaining a functioning open IT-platforms and permanent IT conferences to develop with the participation of practicing lawyers, IT specialists and investment advisers that are commercially attractive and competitive hardware and software solutions for any task and challenges that may apply in legal practice clients [1].

According to a survey conducted in autumn 2016 by Fox Williams and Byfield Consultancy among British law firms occupying the first two hundred places of the business rating, 55 percent of the respondents began to invest in the purchase or development of legal IT products, and, in the amount of not less than 100 thousand pounds.

These figures, of course, are out of date. In the current (2018) year, the participation of large law firms in financing innovation has increased many times, although it continues to be a pale shadow against the background of investment in innovation in the financial market.

Lawyers are positive and understand that the beginning of innovative development of the financial market was laid fifteen years ago. The most respected legal startups have not yet celebrated their fifth anniversary. A large part of the software products in the legal market is still being tested and the majority of lawyers yet don't realize their purpose. In a few years, the demand of lawyers in IT-technologies will become obvious to everyone and after that real investments will come to the industry.

Trusting, long-term relationship can not be established through chatbot, but it is possible by means of personal communication.

This is why most lawyers understand that it is necessary to rely on IT-technology to simplify the solution of technological rather than psychological problems. The attractiveness of innovation is in the fact that the computer robots provide time savings for the preparation and processing of documents, search and analysis of case and statutory regulatory material, the solution of standard tasks will significantly reduce the cost of legal practices and this will allow to expand the clientele in the field of legal services of mass demand: disputes with neighbors and homeowners, divorces citizens with average and below average incomes, wills with a list of property in two lines, small car accidents, conflicts with employers, statements and complaints about the actions of the migration authorities. Of course, none of the lawyers has plans to communicate via chat-bot with representatives of big business. It is possible to exchange emails, messages with them through messengers, but then you still need to get in the car or on a plane and go to a personal meeting [1].

*Legal IT start-UPS (lawtech start-ups) and their products*

TrademarkNow is a legal startup based in Helsinki, Finland, which has turned into an international innovation company over the past few years. It is one of the first startups in the legal business, which managed to attract third-party investors.

This company has proposed software method of "smart recognition" of the main characteristics of patenting objects based on the key elements of their description in patent applications and comparison of these characteristics with the characteristics of any other already patented objects. The founders of the TrademarkNow created user-friendly interface. It intended to use of the software could a person who knows nothing about patents. The target audience is business, but if there is demand, the program can be modified for users-citizens.

Other IT start-ups are developing a more traditional and mass products for practitioners. First of all, these are specialized legal searcher. It is the program of *diligence*. This is the software for drawing up contracts, content analysis, identifying text errors and inconsistencies. The program-consultants are used, including in legal chatbot.

There are startups on the market that carry out state orders to solve the problems of creating an electronic justice system, i.e. transfer of proceedings in certain categories of civil, criminal and administrative cases to the Internet space, as well as the rejection of the paper form of compilation, processing and storage of all justice-related documents.

For example, IT-startup *Netmaster Solutions* based on its software CaseLine, allowing you to analyze and organize trial information, by order of the Ministry of justice of UK (Ministry of Justice) has developed and launched the system of electronic document management and Internet interaction of the courts the criminal jurisdiction of first instance with the parties to criminal trials.

Legal IT is a software product that uses the same hardware capabilities that are granted to all other users in any field of public life. There are no special "legal" computers, servers or smartphones.

Let's consider legal chatbots and Internet portals of communication with clients.

Unlike Terminator or Lunokhod, chatbots have physical embodiment in metal and plastic the Internet robots generating in the text or voice mode on the basis of process of recognition and reproduction of human speech (natural language processing-NLP, natural language generation - NLG) answers to the questions asked them also textually or by voice. The best-known examples are virtual assistants Siri and Alexa [1].

Among all legal chatbots, voice robots are the most popular model in the legal business today, as they allow to imitate friendly, thoughtful and

interested communication of a lawyer with a client with greater or less success

A new generation of online advisers and consultants will appear soon: videobooty capable to show a picture of an attractive human face computer monitor or smartphone screen, imitating the facial expressions of spoken language.

The basis of the chatbots "mind" in law is an array of information on judicial practice on legislation and regulations, up to their projects, on parliamentary discussions, speeches of senior officials, journalistic investigations loaded in their memory. Templates of standard answers to standard questions are pre-loaded in memory of chatbot. Chatbot also remembers all the questions and the answers given to users. Experience shows that no matter how difficult we consider our life, it is always identical and the repetition of the same everyday situations occurs with an amazing periodicity.

At the end of 2016, the first commercial (paid) legal chatbot LISA - Legal Intelligence Support Assistant was launched in the UK. Its peculiarity is that it is able to act as an intermediary in the dialogue between the two sides of the conflict, consultation about which they immediately request from the robot, or subsequently agree to such an exchange of views with the participation of the robot. Thus, according to the developers, there is a serious competitive advantage of their robot to the "live" lawyers, who are not entitled to simultaneously represent both sides of the dispute in connection with the emergence of an acute conflict of interest.

American online legal service Rocket Lawyer and LegalZoom competitor, as legal service providers, exist only in the virtual space. They do not have any offices with soft sofas and coffee for clients and those premises that they still have to use are occupied by powerful servers, computer equipment and IT-specialists serving them. Among the lawyers cooperating with the Internet intermediary, there are a lot of former employees of the largest British and international legal practices, including pensioners, as well as, homeworkers, the number of which multiplies every day, and who accept applications for services to customers only on the Internet.

In all major English-speaking countries, only so-called certified (registered or regulated) providers are eligible to provide paid legal services, i.e. lawyers who have completed the necessary training in higher legal education institutions, passed the qualification exams, received certificates of practicing lawyers or solicitors, and participate in the activities of self-regulatory organizations corresponding to their profile.

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**Аннотация.** В статье охарактеризованы инновации в юриспруденции. Представлен подробный обзор достижений и тенденций в области IT-технологизации юридического бизнеса в англоязычных юрисдикциях. Описаны примеры возможных направлений внедрения и развития IT-технологий в юридическом бизнесе.

**Ключевые слова:** IT-технологии, юридический бизнес, юриспруденция, IT-технологизация, юридический бизнес, чатбот, интернет-портал, он-лайн сервис, консультационный интернет-портал.

**Summary.** The article described innovations in law. The review of achievements and trends in IT-technologization of legal business in English-speaking jurisdictions is presented in detail. Examples of possible directions of implementation and development of IT-technologies in the legal business are described.

**Keywords:** IT-technologies, legal business, jurisprudence, IT-technologization, legal business, chatbot, Internet portal, on-line service, consulting Internet portal.



**ANALYSIS OF THE RELATIONSHIP BETWEEN PRIVATE AND  
PUBLIC LAW IN CRIMEA**

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The relevance of this work for the life of modern Russian society is the problem of division of law system into private law and public law. Even in Ancient Rome there were private law and public law. This distinction is associated with the name of the Roman lawyer Ulpian (170-228), who justified it for the first time. He expressed the view that public law is one that relates to the position of the Roman state, whereas private law refers to the benefits of individuals [2]. So the subject of public law is the sphere of public interest (the interests of society, the state as a whole), and the subject of private law-the sphere of private affairs and interests. It is extremely important to try to find the borders between public law and private law [6].

The main meaning of the distinction between private and public law is to establish the limits of state intrusion into the sphere of property and other interests of individuals and their associations. The state in this sphere should act only as an arbitrator and a reliable defender of the rights and legitimate interests of participants of civil revolution [2].

Private law is a part of the system of rights, a functional and structural subsystem of rights, a set of legal norms that protect and regulate relations between individuals, the basis of which is private property. Thus, private law is a set of rules of law protecting the interests of a person in his or her relations with other persons.

The tradition of private law is typical of the Romano-German legal family: in the common law family and in the Muslim law family, all rights are public, as it is considered that all rights are created or sanctioned by the state [5].

Private law-is the beginning, asserting for individuals legally significant freedom, independence, independence. That is, it is such a legal state of individuals, when they themselves, sovereignly, without outside interference, by their will and in their interest decide their Affairs. We can say this: private law is a sovereign territory of freedom on the basis of law [5].

It is in the area of private law that the freedom of an individual, an

autonomous person, is revealed in its pure form and in its true meaning. Freedom in the field of private law is the complete and sovereign independence of the individual, expressed in his Autonomous and protected status of the subject of law and in possession of his protected subjective rights.

At the same time, both the status of the subject of law and subjective rights have the character of legal phenomena on their basis of absolute order, i.e. they open space for them, at their discretion, behavior and in this regard, in principle exclude, do not allow anyone to interfere in this own "sphere of freedom".

Public law (public) is a set of branches of law governing relations related to the provision of General (public) or national interest.

Publicity as a concept, from the Latin word "publicus" – public, vowel, open has a capacious content. The term "public law" has obvious historical stability and continuity, and also reflects the measure of content that is inherent in the phenomenon. In the legal sense, it refers to an understanding of the law that is different from the right. This is not a sum of acts or norms, it is a holistic understanding of the specifics of law in a socially significant sphere, i.e. in the sphere on which the existence, functioning and development of society and the state, and organized groups, corporations, associations, and citizens depend.

Public law covers many areas. This is the structure of the state and power, spheres of governance and organization of self – government, the expression of public interest as a total, average social interest in each of the spheres – economic, social, etc. This is a universally recognized goal-setting for the actions of all subjects of law, the formation of the foundations and the maintenance of the legal system, ensuring uniform principles of law-making and law enforcement.

At the same time, public law exists with private law relating to the benefits of individuals. Roman lawyer Ulpian characterizes it as a right relating to the position of the Roman state. The criterion for distinguishing between private and public law is interest-for private interests of individuals, their legal status and property relations are of primary importance, for public interests are the main, the legal status of the state, its bodies and officials, regulation of relations with a pronounced public interest. Stability of spheres and methods of legal regulation, criteria of their differentiation explains to us viability of division of the right into private and public. It was reflected in subsequent foreign legal systems, either in a distinct form, or in the form of ideas of the rule of law, or in the form of ideas of a social contract [3].

Conclusion. The structuring of the law by the type of "private-public

"is aimed at limiting the state power, guarantees the" area of freedom" of subjects of law from the manifestations of the sovereignty of the state. This division of law objectively reflects the existence of two relatively independent spheres – civil society and the state. These areas are characterized by various measures permitted and prohibited; some tasks are solved within the framework of public law, others – private. However, the law is uniform in both its manifestations, private and public, and only together can the interests of society, the state and the individual be reconciled.

It is important to clarify that not only the branches of Russian law, but all legal norms of our state are divided into private and public [4]. Thus, the individual branches and institutions of Russian law include the norms of both private and public law, although for each branch of law the share of both is individual (in the constitutional rules of public law prevail, and in the civil-the rules of private law).

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**Аннотация.** Актуальностью данной работы является характеристика деления системы права на отрасли частного права и публичного. Отмечено, что основной смысл различия частного и публичного права состоит в установлении пределов вторжения государства в сферу имущественных и иных интересов индивидов и их объединений. Автор приходит к заключению, что в состав отдельных отраслей и институтов российского права входят нормы как частного, так и публичного права.

**Ключевые слова:** частное право, публичное право, Крым, «область свободы», субъекты права.

**Summary.** The relevance of this work is to characterize the division of the system of law into private law and public one. It is noted that the main meaning of the distinction between private and public law is to establish the limits of state intrusion into the sphere of property and other interests of individuals and their associations. The author comes to the conclusion that the composition of individual industries and institutions of the Russian law includes rules of private as well as public law.

**Keywords:** private law, public law, Crimea, "area of freedom", subjects of law.

UDC 34.05

### **CRIME RATE IN SEVASTOPOL DURING THE PERIOD 2014-2018 YEARS**

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In a year of the Republic of Crimea and the city of Sevastopol transition to structure of the Russian Federation according to which the Minister of internal Affairs on RK Sergey Abisov provided to the magazine "Police of Russia", crime rate considerably decreased, namely on 44%.

In 2015 in Sevastopol the Decree of 31.12.2015 № 122-CL "About Approval of Regulations on Prevention of Corruption and Other Offenses Management of Sevastopol Security and Anti-Corruption Department" was adopted, which contributed to the reduction of corruption.

In 2016, according to RBC estimates based on data from the Prosecutor General Procurator office and Rostat, the crime rate in Sevastopol was 137 per 10 thousand people. The number of crimes committed on domestic grounds has doubled. According to the report of the head of local police Vasyliy Pavlov, there were 2106 persons who committed criminal acts in 2016. More than a third of them were persons who had committed crimes before. And more than a quarter committed criminal acts in a state of alcoholic intoxication [1].

In the category of "Regions with the highest proportion of perpetrators of crimes previously convicted of crimes" Sevastopol is on the second place after the Republic of Ingushetia among the Russian regions. The situation

with drug trafficking in Sevastopol isn't better. During the year, the police identified 299 drug offenses. More than two thirds of them are particularly heavy and very hard.

The high level of child crime is very disturbing. According to the chief city police officer, it grew by 45 percent over the year. The majority of juvenile offenders are from unfavourable families [2].

According to research conducted by the site <http://ruinformer.com> at the end of 2016, Leninskiy district was recognized as the most dangerous one in Sevastopol.

In 2017, according to Sevastopol Prosecutor General Office the number of crimes is increased by almost a quarter, while the country recorded a decrease of crimes. In the Prosecutor General office, the trend of number of crimes increasing in the southern Federal district is mainly explained by the registration of crimes by law enforcement agencies of the Republic of Crimea and Sevastopol based on the results of materials study on criminal cases suspended under Ukrainian law until 20.11.2012. The number of crimes in Sevastopol grew by 23.2 per cent [3].

So in three years in the Crimea and Sevastopol 21 crimes of a terrorist orientation, more than 5.2 thousand crimes connected with drug trafficking, and 406 murders and attempts at murder were recorded.

On March 29, 2018, after two years of silence, the press conference of the chief of Sevastopol city police was held at which he spoke about the level of crime in the city today. "It is probably wrong for me to say and brag about the results achieved in the fight against drugs. Still, crime detection is increased by 34%. We withdraw a very large amount of drugs, including salts. In 2017 we identified three crimes under article 210. These are organized criminal groups which were engaged in the organization and delivery here of drugs", Vasily Pavlov stated. According to his report, the Police Department identified 7 crimes of extremist nature, 8 offenses related to the public demonstration of Nazi symbols and ones of nationalist organizations were stopped. And violence among teenagers decreased, crimes against minors committed two times less. Many forces are exerted by the Sevastopol police officers in fight against corruption, including in their ranks. Pavlov admitted that Ministry of internal Affairs of Russia was the Agency that actually, was fighting against corruption and offenders [4].

According received information we can make a conclusion that crime rate in Sevastopol after the transition to Russia has decreased compared to other years, but we need to act in the same direction, improve the laws, expand the staff of law enforcement officers and provide them with a decent, professional education. And then we will finally be able to achieve the minimum level of crime, not only in Sevastopol, but also throughout

Russia.

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**Аннотация.** В статье дан анализ изменения уровня преступности за период 2014-2018 гг. Отмечено, что происходит снижение преступлений и возможно достичь минимального уровня преступности.

**Ключевые слова:** Севастополь, преступность, преступные группы, правоохранительные органы, коррупционер, севастопольские полицейские.

**Summary.** The article analyzes the changes in crime rate for the period 2014-2018. It is noted that there is a decrease in crimes and it is possible to achieve a minimum crime rate.

**Keywords:** Sevastopol, crime, criminal groups, law enforcement agencies, corrupt official, Sevastopol police officers.

## SECTION 8: NAVAL AND MARINE AFFAIR



UDC 613.6

### THE PROBLEM OF NOISE AND VIBRATION

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Nowadays a great attention is given to the problem of noise and vibration on maritime vessels. It is considered that they are the most important factors which influence on crew's health while working on board a vessel. So the problem of noise and vibration is studied in this paper.

Both crew members and ship owners consider that all above mentioned factors have minor effect on human's health (mental and psychical state).

Vibrations are mechanical oscillations coming from ship's mechanisms and having their own frequency, amplitude, speed and acceleration. But the most destructive influence has oscillation frequency because the human organism has its own internal oscillations of viscera. Very often one and the same part of the body suffers from the same oscillation frequency which has negative effect (especially in the engine room).

One of examples of vibrations influence on the human organism on board a vessel is the influence of instruments which are used by deck department (crewmembers). These vibrations have peripheral effect on hands causing negative consequences, such as: spasms of peripheral vessels,

attacks of fingers whitening in cold weather conditions, lack of mobility and pain at rest and during the night, loss of finger sensitivity, myopachynsis. The other example is the vibration coming from the main engine of vessel. This type of vibration is the most dangerous both in the engine-room and in crew's cabins due to close location of the engine. Such vibrations affect the whole body and are called cerebral. They cause brain vascular disorders and cerebral affection. Influences of these vibrations together or separately cause the effect of "Vibration Disease". Additional negative effect of this disease is observed while working at low air temperatures, under increased noise level and dustiness of air due to cooling of worker's hands during the work with hand-held power tools in uncomfortable pose etc.

Speaking about noises it is found that they have more rapid impact on the human body which differs from vibration. Both vibrations and noises are mechanical fluctuations with certain frequency and ability to extend through air and aquatic environment which interfere the speech perception, information, work and rest. Permanent action of noises reduces physical and mental activity of crewmember. The decreasing of mental activity goes down up to 60% and physical activity to 30%. In spite of the fact that the degree of harm from noises for everyone is individual and depends on the personal qualities of perception, long-range effect causes the onset and the development of nervous and mental disorders, deterioration of motility irrespective of stamina. As a result all above mentioned leads to heightened tension and risk of injury.

Special attention should be given to the effect of noise on person during the sleep period which causes sleep disorder and occurrence of chronic fatigue. At the same time pernicious influence of such noises can lead to loss of hearing. For example noises about 70-90 dB (noise of going train) can cause nervous disorders and noises about 100 and more dB (noise of airplane or working engine-room ) during long-term exposure lead to hearing injury or even to the total deafness. Taking into account living and working conditions on board a vessel, the necessity of being in a closed space during the watches which can last up to 4 hours or more, constant use of tools and the inability to leave noisy area even during the rest period we can come to a conclusion that noises and vibrations acquire even more dangerous character and lead to high level of professional risk and emergence of sharp forms of professional and common diseases.

For reducing danger from the side of noises and vibration certain measures of defense were created. They can be both passive (using of individual defense methods such as headphones and gloves for work with an instrument producing strong vibration) and active which are more effective. Active measures of defense include tuning and equipment



manufacturing with decreased level of noise, using of sound-absorbing materials (for example thick felt, felt, fiberglass) for the additional inside plating and plating of inner compartments. The use of such materials as plastic, rubber, foam plastic is possible in the engine room for decreasing vibration. These 2 methods are very expensive and it is impossible to use them on every vessel. For the purpose of reducing spreading of vibration the replacement and the relocation of mechanisms in the engine-room are undertaken. The most progressive trend is the improvement of mechanisms for reducing vibration and reflecting of noises, even on the stage of their creation. Due to the fact that gloves can't give 100% defense and limit the time of continuous work the improvement of instruments is also required. The special attention is given to materials of shell plating at the stage of planning and building of engine-room compartments (for example CCR – Central Control room).

Due to above- mentioned facts concerning deep study of noises harmfulness and their danger new educational course "Noise and Vibration – The Forgotten Hazards" was introduced. It was represented in accordance with new requirements connected with noise reduction on board a vessel which were implemented together with the adoption of amendments to the International Convention for the Safety of Life at Sea (SOLAS) of July 1, 2014.

The purpose of these amendments was to set standard requirements for building vessels taking into account future noises and vibrations and also establishment of certain possible norms of sound-level and vibration, informing seamen about conditions which can negatively affect their mental and physical health and exact numbers of possible sound-levels. This course has a goal to stimulate seamen to take preventive measures to reduce danger and increase the safety of life functions at sea.

Exposure of noise and vibrations is regulated and all limits for seagoing vessels are given in the ISO standard 6954: Guidelines for permissible mechanical vibrations on board seagoing vessels to protect personnel and crew [6].

It is known that different countries have different norms of noises, so some standards for vessels were set by the International Maritime Organization (IMO).

As seen from the paper it may be stated that the problem of noise and vibration is very important and our authorities take all measures to reduce noise and vibration on board a ship.

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**Аннотация.** В статье рассматривается проблема шума и вибрации на морских судах, показаны основные симптомы вибрационной болезни и причины ее возникновения. Особое внимание уделяется средствам защиты от шумов и вибрации, способам их уменьшения и дополнительным материалам, используемым для этой цели. Анализируются новые требования и поправки к конвенции СОЛАС. На основе проведенного анализа делается вывод, что проблема очень важная и, что власти предпринимают все меры для уменьшения шума и вибрации.

**Ключевые слова:** шум, вибрация, судно, влияние, опасность.

**Summary.** The paper studies the problem of noise and vibration on maritime vessels, shows the main symptoms of Vibration Disease, their types and main causes of occurrence. Special attention is given to means of protection from noises and vibration, ways of reducing them and additional materials used for this purpose. New requirements and amendments to SOLAS convention are also analysed. On the basis of the undertaken review, it is concluded that this problem is very important and our authorities take all measures to reduce noise and vibration on board a ship.

**Keywords:** noise, vibration, vessel, influence, danger.

## **THE PROBLEM OF MARITIME PIRACY AND HOW TO PREVENT IT**

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Maritime piracy has terrorized ocean shipping since ancient times. Piracy, in its original form of the sea invasions, appeared simultaneously with the shipping and sea trade. In ancient times it was considered that pirates, sailors and merchants were simlized to occupations, without which the maritime shipping of those times could not exist. Pirates operated in the Pacific Ocean, along the Chinese coast, among the islands of the South China Sea, off the coast of Norway, in the Mediterranean Sea. In the process of time, the trade routes were developed, as well as the trade between countries, there were more and more attacks on ships from pirates.

The word piracy came to us from the Greek "πειρατής", which means a robber, a pirate.

In the international law, the term "piracy" is an international crime including the highjacking of a ship, robbery or sinking of commercial or civil ships committed on the high seas. Pirates are sea and river robbers of any nationality, they rob the ships of all countries and nations.

Taking into account the great damage to trade caused by the piracy, and changes in the political situation, it became necessary to start anti-piracy campaign. In the XIX century European powers adopted a number of agreements to combat piracy, such as the Monroe Project in 1832, the

Paris Declaration of 1856. So, by the middle of the XVIII century - the beginning of the XIX century there was a strong opinion that the piracy is an international crime, and every pirate is an enemy of the human race. A study of the piracy history leads to a conclusion that it has undergone many changes, and today there are great differences between the Ancient pirates and the pirates of the 21st century.

Despite the creation of a legal framework at the international level and the call of the international community to combat this act by joint actions, it is impossible to eradicate the maritime piracy. Modern piracy has especially attracted the attention of the world public since 2008: at that time reports of

piracy attacks were almost every day. Maritime piracy, its evaluation and analysis of data allow us to come to the conclusions that: according to the International Maritime Organization, the situation at sea remains unstable to this day, and in some places, such as the South China Sea and the Western part of the African continent this unstable situation continues to grow from year to year.

Analyzing the situation, we must ask the question what measures are being taken to counteract piracy.

In the United Nations Convention on the High Seas of April 29, 1958 (Article 15, 23), pirates were defined as "an unlawful act of violence, detention or robbery committed for personal use, on the high seas, against any ship or aircraft, persons or property in a place which is outside the jurisdiction of any state. According to the Convention, all states are obliged to contribute to the eradication of piracy on the high seas and in all other places which are beyond the jurisdiction of any state.

One of the main international regulations in the field of maritime safety is the International Convention for the Safety of Life at Sea, 1974 (SOLAS 74), adopted by the International Maritime Organization (IMO). Initially SOLAS 74 was aimed at the organizational and technical equipment of ships, ensuring their safety. Later, there were measures to combat piracy, providing for international cooperation.

The 1982 United Nations Convention on the Law of the Sea (entered into force on November 16, 1994) reaffirmed the fundamental principles and norms of the Convention on the High Seas. In the articles 101 107, 110 111 the content of the provisions of the Convention on the High Seas is reproduced almost word for word. The law of the sea gives the warship of any state the opportunity to counter piracy on the high seas.

Unlike the Convention on the High Seas of 1958 and the 1982 United Nations Convention on the Law of the Sea, the aim of the Convention (1988) is to suppress a wider range of criminal encroachments. Firstly, the subject of regulation in it is the fight against illegal acts in international maritime navigation. Secondly, the essential difference lies in the sphere of application: the 1988 Convention extends to acts committed in various categories of maritime areas - in inland seas, in territorial waters, on the high seas. Thirdly, the operation of the Convention does not extend to aircraft. Fourthly, in the 1988 Convention, the question of the jurisdiction of States with respect to criminal encroachments was resolved differently than in previous international treaties. So, what about piracy, any state has the right to suppress (universal jurisdiction) acts of violence.

In October 1992, the International Maritime Bureau of the International Chamber of Commerce, with the support of the International

Maritime Organization in Malaysia in Kuala Lumpur, established the Regional Center on Piracy, which was later renamed the Analytical Center on Piracy. It collects and analyzes information globally, searches for missing ships, achieves punishment for criminals and returns cargo to owners, carries out round-the-clock warning of ships about pirate attacks and organizes assistance to the vessels in distress.

On July 1, 2004, the International Ship and Ports Security (ISPS) Code of the International Maritime Organization came into force, which became an integral part (Chapter XI 2) of the International Convention for the Safety of Life at Sea (SOLAS 74). The Code establishes unified safety standards that are mandatory for all participants of international shipping of goods and passengers. The purpose of the ISPS Code is to prevent pirates from boarding the ship, however, if they did penetration, the crew must know how to reduce or eliminate the negative consequences.

The International Maritime Organization has also developed a number of recommendations with a view to prevent and combat piracy and armed robbery of ships:

- recommendations to governments on preventing and combating piracy and armed robbery of sea vessels (1999);
- Instruction to shipowners, shipping companies, ship captains and crews for the prevention and suppression of piracy and armed robbery of sea vessels (2002);
- Directives for maritime rescue coordination centre (MRCC) (2000);
- Temporary procedures for MRCC to receive distress signals (2000);
- Resolution A. 922 (22) code of conduct for the investigation of piracy acts and armed robbery of sea-going vessels;
- Resolution A. 923 (22) of the "ghost" ship and the registration process.

Let us turn to practice. Here's an example of the current measures to combat piracy such as the Frigate of the Navy of Denmark HDMS Absalon, being a member of the naval forces coalition, namely: the 150<sup>th</sup> Joint Operational Group, an participant in Operation "Enduring Freedom" (originally called "Infinite Justice"), the 151<sup>st</sup> Mixed Task Force. The frigate, whose goal was to combat piracy and improve maritime safety performed her duties properly. In September 2008, HDMS Absalon prevented two pirate attacks, stopped the highjacking of a ship and seized 10 pirates on board of two skiffs with weapons and boarder tackle on board. But then it turned out that the Danish authorities suddenly realized that legal problems might arise, since the Danish interests in the incident were not directly affected. In addition, a sharp rejection of the very idea of the pirate betrayal in Denmark was expressed inside the country. None of the

countries with which Denmark has negotiated expressed willingness to accept persons for the purpose of being brought to justice. As a result, the Danish authorities ordered to dismiss 10 suspects who were taken to the Somali coast after 6 days of their arresting. Danish Minister of Defense Søren Gad stated that the Danish Minister of Justice came to the conclusion that the suspects could not be prosecuted under the Danish law. Captain Dan Thømasen, HDMS Absalon commander, said it would be an illusion to think that the pirates would be prosecuted if transferred to the Somali authorities, but added that there was nothing else left to do. Meanwhile, on September 20, the frigate faced two more pirate ships, with RPGs and other weapons on board. This time, remembering the previous embarrassment, the Danes seized all weapons, but dismissed all the persons on the floating boat. Then, on December 4, 2008, HDMS Absalon intercepted a ship drifting due to engine breakdown off the coast of Yemen, discovered on board seven crew members who had been without water and food for several days. The inspection team also found on board a certain number of RPGs and AK-47s. The suspects were handed over to the Yemeni authorities. On January 3, HDMS Absalon intercepted three suspicious pirate ships with 10 pirates armed with RPGs, automatic and short-barreled weapons. In this case, there was no evidence of the detainees involvement in pirate attacks and they were allowed to continue their way, though - without weapons. As a result of these and other cases, by the end of March 2009, by the end of the anti-piracy mission and returning to Denmark, the frigate had come in contact with 88 of the total 250 pirates detained during the same time by all the coalition forces, seized about 60 weapons and 9 boarding gangways, and even more were flooded in the ocean during her raids. But nobody of suspects was prosecuted in Denmark, many of them were dismissed with further notice showing nonconformity of theory and practice in containing piracy.

In conclusion, as seen from the article the threat of maritime piracy has increased especially in the last few years. A great attention should be given to this problem. Countries all over the world combat piracy, but the problem has not been resolved yet.

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**Аннотация.** В последние годы наблюдается значительный рост числа нападений пиратов на суда. В статье исследуется проблема морского пиратства, дается определение термину "пиратство", исследуется его история, описываются основные Конвенции и меры, принимаемые для борьбы с пиратством. Ряд рекомендаций, инструкций и резолюций по предотвращению и борьбе с пиратством, а также вооруженного разбоя на судах представлены в данной статье.

**Ключевые слова:** пиратство, захват судна, конвенция, безопасность, бороться.

**Summary.** In recent years, there has been a significant increase in the number of attacks on vessels by pirates. The paper studies the problem of marine piracy, gives the definition to the term piracy, investigates its history, describes the main Conventions adopted to combat piracy and measures which are taken to counteract it. A number of recommendations, instructions and resolutions to prevent and combat piracy and armed robbery of ships are also given in this article.

**Keywords:** piracy, highjacking of a ship, convention, safety, to combat.

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## ALTERNATIVE ENERGY AND FUEL IN SHIPPING

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The relevance of this topic is conditioned by the fact that the ship needs a large amount of fuel for her operation. That has a detrimental effect

on the state of the environment, because huge cargo ships annually emit millions cubic meters of carbon dioxide into the atmosphere, causing great damage to the atmosphere and bringing the melting of glaciers at the poles. Also, due to unstable prices for oil products and limited supplies of these minerals, engineers are constantly looking for alternative fuels and energy sources.

World shipping is the main source of environmental pollution, as world trade requires a huge amount of consumption of oil and other combustible materials for sea vessels, but as more attention is paid to reducing CO<sub>2</sub> emissions, it becomes clear that the time has come to make changes in power plants or do their replacement.

Currently, within only one country, the consumption of motor fuels produced from oil can reach hundreds of millions of tons. At the same time, automobile and sea transport are among the main consumers of petroleum products and will remain the main consumers of motor fuels for the period up to 2040-2050.

Another significant step to the development of this issue is the fact that, in accordance with the requirements of the International Convention for the Prevention of Pollution from Ships, there is a systematic tightening of the requirements for the content of sulfur, nitrogen and carbon oxides, as well as particulate matter in marine emissions [1, p. 49]. These substances cause enormous harm to the environment and are alien to any part of the biosphere.

The most stringent requirements are advanced for Emission Control Areas (ECA). Namely:

- Baltic and North Seas;
- Coastal waters of the USA and Canada;
- The Caribbean Sea;
- Mediterranean Sea;
- Coast of Japan;
- The straits of Malacca and others.

Thus, the changes in the norms for the emission of sulfur oxide from sea vessels to date are 0% and 3.5% in special areas and throughout the world, respectively. And by 2020, the norms for emissions of sulfur oxide from sea vessels in these areas will be similarly 0%, and throughout the world will already fall to 0.5% [2, p. 18]. Hence, the need to solve the problem of reducing chemical emissions into the atmosphere of harmful substances by ship power plants and the search for new, more "friendly" fuels or energy for the use of the latter on ships.

To address these issues, innovation is proposed in two different directions:



1) Use of new, more environmentally friendly and economical fuels in the operation of ships;

2) Refusal from the fuel in favor of using the energy of the sun, water, wind.

Let's consider the first way. The main types of alternative fuels are the following:

- Biodiesel. It is an organic fuel produced from oil crops.

The price of biodiesel brand is approximately two times higher than the price of conventional diesel fuel. Studies conducted in 2001/2002 in the United States showed that when fuel contains 20% of biodiesel, the content of harmful substances in exhaust gases increases by 11% and only the use of pure biodiesel reduces emissions by 50%;

- Spirit. This is organic compound containing one or more hydroxyl, directly attached to a carbon atom. Spirit is prohibited as a fuel with a low flash point;

- Hydrogen. This is the only type of fuel whose combustion product is not carbon dioxide;

Used in internal combustion engines in pure form or as an additive to liquid fuel. The danger of its storage on board and the expensive equipment for such use make this type of fuel completely unpromising for ships;

- Water fuel emulsion is produced on a ship in a special installation - at the same time fuel is saved, nitrogen oxide emissions are reduced (up to 30% depending on the water content of the emulsion), but does not significantly affect sulfur oxide emissions;

- Liquefied and compressed combustible gases make it possible to eliminate emissions of sulfur and particulate matter into the atmosphere, crucially reduce emissions of nitrogen oxides by 80%, and significantly reduce carbon dioxide emissions by 30% [2, p. 27].

Thus, it can be argued that natural gas is the only new type of fuel the application of which significantly affects the environmental performance of marine engines.

Now let's turn to the second way. Wind and sun are the most common sources of energy on earth. Many organizations offer different projects to introduce them into everyday life [3, p. 125].

In international practice there are already several realized and still unrealized projects of vessels using wind and solar energy for their voyage.

In an effort to reduce fuel consumption on large merchant ships of the fleet in the world's oceans, a group from the University of Tokyo has developed the "Wild Challenger" project.

Using giant retractable sails, whose dimensions are 50 meters in height and 20 meters in width, the annual fuel consumption can be reduced by

almost 30 percent. To obtain maximum traction, the sails are individually controlled, and each sail is telescopic with five tiers, which allows them to be folded when the weather becomes unfavorable. Sails hollow and curved are made of aluminum or reinforced plastic, which makes them more like wings. Computer modeling, as well as wind tunnel tests, showed that this concept is capable of working even in the side wind. Thus, the project "Wind Challenger" can really become the development of economical vessels of the future generation [4, p. 16].

The company "Eco Marine Power" has developed the project "Aquarius". The peculiarity of this project is the use of solar panels as a sail.

Such sails even got their own name "hard sail". They will be part of a major project that will allow sea vessels easily use alternative energy sources, while at sea, in the roads and in the port. Each sail panel will automatically change position using computer control, which is developed by the Japanese company KEI System Pty Ltd. Panels can also be removed under adverse weather conditions.

The latest achievement in the field of solar technology means that now it is possible to use a combination of solar batteries and sails, and this fact brings this project to the forefront in the development of modern shipbuilding.

The Aquarius system is designed in such a way that it does not require much attention from the ship's crew and is relatively easy to install. Materials from which the rigid sail and other components of the system are made are processed.

The "Aquarius" system will become attractive for investment by shipping companies and ship operators, due to the rapid payback of the project [5, p. 88].

It can be concluded that both these paths are designed to solve the same problems. The implementation of these projects has a significant impact on the world's maritime transport, contributing to a significant reduction in environmental pollution and a reduction in fuel and service costs. What to choose is everyone's business. An easier way to implement is the use of fuel-efficient fuel, since this technology does not require a complete replacement of the fleet, and can be used on existing ships, but at the same time a certain level of fuel costs and emissions of harmful substances to the atmosphere. The choice in favor of the construction of vessels that in their operation use alternative energy sources, on the one hand, requires a complete replacement of the fleet, but, on the other hand, excludes fuel costs and significantly reduces various types of pollution of the environment.

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**Аннотация.** Данная статья фокусируется на проблеме загрязнения атмосферы с судов и способах снижения ущерба для окружающей среды. Целью исследования является подробный анализ более экологичных и экономичных видов топлива, которые могут стать реальной альтернативой нефти и другим горючим материалам, используемым в судождении на сегодняшний день. Также затрагивается тема использования альтернативной энергии в судоходстве, а именно, энергии солнца, воды и ветра. Определены действующие проекты и вектор движения науки.

**Ключевые слова:** окружающая среда, загрязнение атмосферы, природный газ, альтернативное топливо, энергия солнца, система «Водолей».

**Summary.** This article focuses on the problem of air pollution from ships and ways to reduce damage to the environment. The aim of the study is a detailed analysis of more environmentally friendly and economical fuels that can become a real alternative to oil and other combustible materials used in navigation nowadays. The topic of using alternative energy in navigation, such as the energy of the sun, water and wind, is also touched upon. The existing projects and the vector of the movement of science are determined.

**Keywords:** environment, air pollution, natural gas, alternative fuel, solar energy, «Aquarius» system.

## **BOILER EFFICIENCY INCREASE BY MEANS OF USE OF HEAT RECOVERY SURFACES**

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A ship's boiler is a device designed to produce a heat carrier (steam, water or special oil) for certain operational purposes. Most ships of the world fleet are equipped with steam boilers. Ship steam boilers can be divided into main and auxiliary ones. The main boilers generate steam for the main engine - a steam engine or a steam turbine. Auxiliary boilers provide steam for some auxiliary mechanisms (mainly on tankers), as well as heating, fuel heating, steam-fighting, heating of cargo on tankers, household needs [1].

By their design, boilers are classified into water-tube and fire-tube ones. In water-tube steam boilers, water and steam-water mixture move inside tubes that are flushed externally with hot flue gases. In the fire-tube (gas-tube) steam boilers, on the contrary, the flue gases move through the tubes, and the water flushes them from the outside.

One of the indicators of the economy of the boiler is the coefficient of efficiency. This indicator characterizes the ratio of the useful effect and the cost of obtaining it, taking into account all the heat losses during the operation of the boiler.

It is necessary to analyze the heat losses of the boiler in order to understand how to increase its efficiency.

Thermal losses with flue gases are reduced by using the tail heating surfaces. The tail surfaces are devices (additional ones) that use the heat of the combustion products after the evaporation beam, thereby increasing the efficiency. These include: an economizer, an air heater, an economizer.

The loss in the incomplete chemical combustion of fuel increases with a decrease in the excess air ratio, at a low temperature and an inadequate

volume of the furnace. With a rational layout of the boiler and its proper maintenance, this loss can be reduced to a very small value.

The loss of heat to the environment through the external surfaces is determined by the size of the boiler, the quality of insulation, the layout of the air channels and the skin [3].

All these heat losses lead to a decrease in efficiency. The amount of losses must be minimized to improve the efficiency of the boiler. Especially the efficiency is affected by the thermal loss with outgoing gases. Therefore, in order to minimize it, it is necessary to equip the boiler with a number of units, such as an air heater, an economizer and a superheater.

The initial parameters of steam (pressure and temperature) produced by the boiler significantly affect the efficiency of the steam power plant. The greatest influence on its efficiency is the increase in the temperature of superheated steam. Thus, when the temperature is raised by 20-25 degrees, the overall efficiency of the steam installation increases by approximately 1%.

To produce superheated steam, steam superheaters are used, the device of which depends on the type and design of the boilers. Steam superheaters are divided as follows: by the location of the pipes - vertical and horizontal; by design - serpentine, loop and with tubes of small deflection; by the method of heat perception - convective, radiation and combined. As a rule, only convective superheaters are installed in ship water-tube boilers.

The most widespread in modern water-tube boilers were horizontal loop and coil superheaters.

One of the main drawbacks of horizontal superheaters is the possibility of slacking of pipes during operation, as a result of which heat transfer deteriorates and efficiency decreases (due to violation of step relations).

When using coil superheaters, it is possible to obtain any superheat temperature, but high demands are placed on the purity of the steam, since the internal surface of the pipes is practically inaccessible for mechanical cleaning.

The use of coil superheaters will be more expedient since it is possible to obtain high-parameter steam, and the internal surface can be cleaned with a chemical solution.

Therefore, an increase in the efficiency of the boiler by 1% due to the use of a superheater significantly affects its efficiency [ 2].

The use of an economizer also affects the efficiency of the boiler. They are usually installed directly behind the evaporative heating surface of the boiler before the air heater. Heating of the feed water entering the steam boiler makes it possible to reduce the dimensions of its vaporizing surface and increase the efficiency of the boiler.

According to the design, the economizers are divided into serpentine and looped ones, the type of surface heating - smooth-tube, fin, needle and ribbed. In ship boilers economizers are used, the water temperature of which is 40-60 °C below the boiling temperature. They are called non-boiling. Smoke-tube economizers were the most widely used on ships because of simplicity of manufacture, operation and repair.

According to statistical data, the economizer, which is installed on boilers with very high capacity, is able to increase the boiler efficiency by 4% -7%. If we talk about the scale of industrial, then these figures are of great importance for the environment. Thus, if an economizer were used on each boiler, energy savings would be enormous.

The use of an air heater improves the combustion of fuel in the furnace and increases the efficiency of the boiler by 5-6% or more. The higher the temperature of the air heating, the greater the fuel economy and the higher the efficiency of the boiler. Practically the heating temperature is usually in the range of 120-200 °C.

By design, air heaters are divided into tubular, made of round, oval and other forms of pipes (the latter can have ribs from the outside and inside), and lamellar, made of smooth steel sheets.

The most widespread in ship installations received tubular air heaters, which, depending on the location of the pipes are divided into vertical and horizontal. The use of horizontal air heaters makes it possible to reduce the dimensions of the water-tube boilers due to their better arrangement. [4]

For comparison, let us cite a number of different boilers.

The auxiliary boiler KV35, which is the prototype of all KV-type boilers, was not equipped with tail surfaces. The steam capacity of the boiler is 35 t / h, the saturated steam pressure is 2.65 MPa, the efficiency is 85%.

The modernized boiler KV35-1 differs from KV35 by the presence of a two-section coil superheater. This increased the efficiency to 91%. To maintain the boiler in a hot stand in the water collector there is a water heater, which uses heating steam from the main boiler.

The structural feature of the boiler KV 2 is the use of a two-collector loop superheater, the surface of which is made of one row of loops. Steam capacity 25 t / h, steam pressure 1.75 MPa, efficiency 84%.

Two-section air heater in boiler KV1 provides air heating up to 120 °C. Due to the increase in the heating surface of the air heater and the reduction of the excess air factor to 1.1, the efficiency is increased to 95%. A small excess of air is due to the possibility of using exhaust gases in an inert gas system to create an explosion-proof environment in tanks.

Upgraded boiler KV1-1 it differs from KV1 by the presence of a vertical two-collector superheater. There is no economizer and water heater in the water collector, the efficiency of the boiler is 2% lower, and the steam capacity is 5 t / h less than that of KV1.

In conclusion, we can say that in the current economic situation in the world, with high fuel prices and high environmental standards, there is a need to apply tail heating surfaces. Correct design of the boiler and a correctly formulated heat balance make it possible to significantly improve the efficiency of the boiler.

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**Аннотация.** В статье ставится задача рассмотреть способы повышения эффективности котла. Подробно рассматривается способ глубокой утилизации тепла продуктов сгорания. В результате анализа было установлено, что потеря тепла с уходящими газами составляет большую часть, поэтому на ее утилизацию необходимо делать особый акцент. Посредством дополнительных поверхностей нагрева, решается проблема потерей тепла. Но установка данных устройств несколько усложняет конструктивный и тепловой расчет котла, а также повышает его стоимость. Подводя итог работе, можно сказать, что применение хвостовых поверхностей нагрева значительно повышает КПД котла, и средства, затраченные на его постройку, в скором времени окупаются.

**Ключевые слова:** котел, хвостовые поверхности, тепловые потери, экономия топлива, повышение КПД.

**Summary.** The article aims to consider ways to improve the efficiency of the boiler. The method of deep utilization of heat of combustion products was considered in detail. As a result of the analysis, it was found that the loss of heat with outgoing gases is a large part, therefore, special emphasis must be placed on its utilization. By means of additional heating surfaces, the problem of heat loss is solved. But the installation of these devices somewhat complicates the design and thermal calculation of the boiler, as well as its cost. Summing up the work, we can say that the application of

heat recovery surfaces significantly increases the efficiency of the boiler and the means spent for its construction will soon be repaid.

**Key words:** boiler, heat-recovery surfaces, thermal losses, fuel economy, increase of efficiency.

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## **THE NECESSITY TO DEVELOP MANDATORY REQUIREMENTS FOR SHIP RECYCLING**

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Modern ships have a lifespan of 25 to 30 years before corrosion, metal fatigue and a lack of parts render them uneconomical to run. The only way to profit from old ships is recycling.

Ship recycling is a type of ship disposal involving the breaking up of ships for either a source of part, which can be sold for re-use, or for the extraction of raw materials, chiefly scrap. It may also be known as ship dismantling, ship cracking, or ship recycling. Ship breaking allows the materials from the ship, especially steel, to be recycled and made into new products. This lowers the demand for mined iron ore and reduces energy use in the steelmaking process. Equipment on board the vessel can also be reused. While ship breaking is sustainable, there are concerns about the use of developing countries without stringent environmental legislation. It is also considered one of the world's most dangerous industries and very labour-intensive [1].

In 2017, approximately 743 ocean ships reached the end of their service life and were broken down to recover steel. Yet only a fraction was handled in a safe, sustainable manner. More than 70% of all end-of-life ships were simply run ashore on tidal beaches in developing countries such as Bangladesh, India and Pakistan, where unscrupulous shipbreaking companies exploit minimal enforcement of environmental and safety rules to maximize profits. But the remaining 30% also remain an issue – ship recycling facilities in Turkey and China still face massive difficulties in complying with all standards of environmentally sound management of hazardous waste [2].

Their recycling is conducted in the most primitive way - with the help of autogen and manual labor. Workers are often exposed to asbestos used



for insulation in older ships, and to paint containing lead, cadmium and arsenic. Workers often die from gas poisoning or explosions and fires [3].

On the beaches of South Asia, poor and unskilled migrant workers are deployed by the thousands to break down the ships manually. The ships are full of toxics such as asbestos, lead and heavy metals and little care is given to worker safety or protection of the environment. The toxic wastes sicken the workers and ravage coastal ecosystems, and because the muddy sand and shifting grounds of tidal beaches cannot support heavy lifting equipment or safety gear, accidents injure or kill hundreds of workers each year.

All these problems attracted the attention of the Convention of the International Maritime Organization on the need to develop mandatory requirements for the recycling of ships.

The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (the Hong Kong Convention), was adopted at a diplomatic conference held in Hong Kong, China, from 11 to 15 May 2009, which was attended by delegates from 63 countries.

The Convention is aimed at ensuring that ships, when being recycled after reaching the end of their operational lives, do not pose any unnecessary risks to human health, safety and to the environment.

The Hong Kong Convention intends to address all the issues around ship recycling, including the fact that ships sold for scrapping may contain environmentally hazardous substances such as asbestos, heavy metals, hydrocarbons, ozone-depleting substances and others. It also addresses concerns raised about the working and environmental conditions at many of the world's ship recycling locations.

The text of the Hong Kong Convention was developed over three and a half years, with input from IMO Member States and relevant non-governmental organizations, and in co-operation with the International Labour Organization and the Parties to the Basel Convention [4].

The Ship Recycling Facility Plan (SRFP) shall be adopted by the board or appropriate governing body of the Recycling Company. The SRFP is the main document that the Competent Authority (ies), or organization recognized by it, will rely on in authorizing a Ship Recycling Facility.

The programmes included in the Ship Recycling Facility Plan can be subdivided into two categories: those which are aimed at protecting workers' safety and those aimed at protecting the environment.

Regulation 19 of the Convention specifies that the Ship Recycling Facility shall establish and utilize procedures to prevent explosions by ensuring that Safe-for-hot-work and Safe-for-entry conditions are

established and maintained throughout the ship recycling process; to prevent other accidents that cause or have the potential to cause damage to human health; and to prevent spills of cargo residues and other materials which may cause harm to human health and/or the environment. Since these are among the more critical aspects for the safe operation of Ship Recycling Facilities, it is important that the SRFP clearly demonstrates that it has procedures in place to prevent workplace accidents and injuries.

The Ship Recycling Facility Plan (SRFP) should include procedures for ventilation, personnel monitoring for heavy-metals exposure, protection of personnel, training, respiratory protection, torch cutting, permits and inspections (including hot-work certification). The SRFP should include procedures for transporting, moving, securing, storing and using hoses and torches.

The SRFP should include a description of washing facilities, showers, eating and recreation areas, toilet facilities and changing rooms. It is recommended that appropriate changing rooms and sanitary and washing facilities should be provided by the Ship Recycling Facility to control exposure and avoid the spread of Hazardous Materials. Sanitary and washing facilities should be conveniently accessible and situated so that they are not at risk of contamination from the workplace. It is also recommended that the Ship Recycling Facility should designate separate and uncontaminated areas for workers to use for eating, drinking and other breaks.

The SRFP should describe how the programmes on the protection of the employees are in compliance with national regulations.

The Ship Recycling Facility Plan (SRFP) should describe the environmental monitoring programme aimed at preventing possible negative impacts to the environment during ship recycling, such as:

- releases of Hazardous Materials to ground and sediments;
- releases of Hazardous Materials to water;
- emissions of Hazardous Materials to air; and
- noise/vibrations.

The monitoring programme, if included in the Ship Recycling Facility Plan (SRFP), should be Facility-specific, taking into account the Facility's characteristics, such as the use of dry dock, jetty/piers and/or recycling plots on land-sea interface, and should identify chemical, biological and physical changes in the environment surrounding the Ship Recycling Facility. The monitoring programme, if included in the SRFP, should utilize well-established standards for the sampling and analysis of relevant environmental parameters.

The purpose of developing and implementing a programme for spill

prevention, control and countermeasures is to minimize the risk of spills and leaks that could adversely impact the environment.

Storm-water run-off from industrial facilities has the potential to adversely affect the environment. Improper storage and handling of Hazardous Materials and wastes could increase the risk of environmental degradation through contact with water. The SRFP should include a programme that defines measures to be implemented and maintained to minimize the potential for storm-water contamination at the Ship Recycling Facility.

A programme for the prevention of storm-water pollution should include the identification of all potential pollutant sources at the Ship Recycling Facility that could come into contact with storm water, with the nearby receiving waters and with storm water-conveyance systems.

The introduction of debris into the marine environment by ship recycling activities has the potential to adversely affect the environment. The Ship Recycling Facility Plan (SRFP) should include a programme that defines measures to be implemented and maintained to minimize the potential for debris deposition into the water, including the maintenance of areas from which debris might be transported into the marine environment by wind, storm drains, tides or run-off. Control measures should be implemented to reduce the likelihood of debris deposition [5].

If all the rules of this convention are carried out honestly and conscientiously by ship owners, one hundred percent certainty can be said that the danger of human life and the environment will decrease every year.

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**Аннотация:** Ежегодно создаются сотни кораблей и судов, но, когда срок службы устаревших судов заканчивается, их списывают и отправляют доживать остаток своих дней на пляжи развивающихся

стран, где рабочие, не задумываясь о своей безопасности, занимаются демонтажем судов, подвергая себя смертельной опасности, а также загрязняя окружающую среду. В связи этим международная морская организация начала проводить собрания для поиска решений этой проблемы. В Гонконге состоялось ключевое совещание, на котором была принята самая важная Конвенция для решения проблемы: «Гонконгская международная конвенция о безопасной и экологически обоснованной рециркуляции судов». В ней был разработан План утилизации судов и набор правил и требования по безопасной утилизации судов.

**Ключевые слова:** рециркуляция судов, конвенция, Гонконгская конференция, план рециркуляции судна, обязательные требования, безопасность рабочих

**Summary.** Every year hundreds of ships and vessels are created, but when the service life of the obsolete ships ends, they are written off and sent to live out the rest of their days on the beaches of developing countries, where workers not thinking of their safety, are engaged in dismantling ships, exposing themselves to mortal danger, as well polluting the environment. In this regard, the international Maritime organization began to hold meetings to find solutions to this problem. A key meeting took place in Hong-Kong where the most important Convention was adopted to solve the problem - "the Hong Kong international Convention for the Safe and Environmentally Sound Recycling of Ships. It established The Ship Recycling Facility Plan and set of rules and requirements for the safe recycling of ships.

**Key words:** ship recycling, the Ship Recycling Facility plan, convention, Hong-Kong conference, workers' safety, mandatory requirements.

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## LIGHTWEIGHT DESIGN IN SHIPBUILDING

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Lightweight design is attributed to an increasing importance in many industries, including shipbuilding. Many shipping companies and shipyards are due to their customers' requirements in the situation to reinvent their products within short periods of time. Besides saving raw materials and reducing energy needs, improvements in end product performance should also be considered.

The aim of this work is to show the lightweight design and its influence on the shipbuilding. The particular attention will be paid to the lightweight design concept. The actuality of this article is in the discussion of the different materials used for lightweight design.

The request of lightweight design is to use maximal available material resources in terms of capacity with the minimum weight. The stiffness and allowable strain in the operating conditions should be also taken into consideration. Since there is a great number of variables such material, fabrication, joining, assembly, maintenance and recycling, designers are dealing with different controversies to reach optimum light construction. The most essential parameter for choosing the appropriate material is costs of applied materials, manufacturing and testing. That's why it is necessary for perform the entire product life detailed analysis of advantages of application of lightweight materials and cost of producing the construction.

One of the main reason of application of lightweight structures is the advantages of joining by welding. High load capacity of welds and the possibilities of their design and performance significantly enhance the concept of constructions structure.

Key role in developing and implementing lightweight design have new materials. For example, a compound of metal and polymer materials provides a high quality material that integrates extreme rigidity and low weight. Use the "active elements" (transducers) can obtain in future such material systems that can adapt to any kind of external load. So it could be highlighted that the lightweight design is interdisciplinary engineering approach which aims to develop a system of minimum weight that in the given conditions successfully fulfill the desired function with optimal utilization of available resources. Requirements for lightweight structures are always extreme, always related to new materials, information and production technologies and solving specific problems.

In the course of development process of lightweight structures, the following strategies play a key role: terms for performing lightweight design, the concept of lightweight design, materials for lightweight design and types of lightweight structures.

Speaking about performance of lightweight design the focus should be given to the purpose of lightweight design, the possible savings by using

lightweight design and its influence on environment, so called eco-lightweight design. The purpose of the lightweight design includes requirements related to the function of the entire system. Reducing weight is only necessary and appropriate to the fulfillment of prescribed function of the system. So a detailed analysis of service conditions, reliability, security and functionality of the entire structure is required. Savings using lightweight construction involves reducing production costs, reduce consumption of materials and production processes by integrating these functions. Eco-lightweight design must meet the requirements related to the ecology and economy of the structure of lightweight constructions. These requirements depend on the social, political, legislative and market. So, in terms of performance lightweight construction highlighted are a number of factors that are related to the structure of lightweight construction in terms of legislation (regulations and standards), operating conditions, customer demands, maintenance, required to fulfill the work function claims related to environmental protection, etc.

The regulation and standards. The research projects and development in the lightweight design sphere that have been carried out have been made possible by the function-based regulation added to IMO's SOLAS Regulations, the Regulation 17: "Alternative design and arrangements". The rule permits vessels to be built using materials other than steel provided that the flag state's representative (in Sweden, the Swedish Transport Agency) approves the design and construction. This, in turn, requires documentation showing an adequate safety level.

The concept of lightweight design is often considered as a system of lightweight construction, and it represent a method for reducing the weight of technical systems or subsystems that take into account all the variable activity in the system as well as general technical and economic constraints. Weight of the entire system can be reduced by the systematic analysis of the applied structure of parts, components and modules and their optimization in a system of lightweight design. Sensors and control units are mounted on the structure, by using active materials, composite materials, piezo elements and Carbon-Nano-Tubes.

The number, variety and quantity of materials used today are increasing. It is estimated that today in the application of more than 70 000 types of technical material. As a consequence of the rapid development of military technology in the last 50 years in use is entered more new materials than in all previous centuries. Materials based on iron are stagnating in the production and consumption, while increasing the share of application of aluminum, titanium, magnesium and other alloys, polymer and ceramic composites and special materials. The required characteristics of the

material can be obtained by a combination of materials with specific properties, where the dominant role have composite materials. It is anticipated that in the 21st century will be the intensive production and use of polymeric materials and in a mid-century should be counted with increasing application of composite and ceramic materials

Lightweight design materials must meet a number of requirements that can be met by using lightweight materials of high stiffness and strength. Weight reduction can be achieved by using lower density materials. The most commonly used material for lightweight construction are metal and non-metal materials, composite and active materials. Metal materials comprise aluminum, magnesium, titan, steel (conventional lightweight design). Non-metal materials are of two types: plastics and ceramics. Composite group consists of composite fiber, ceramic composite materials and metal composite materials. The most common used active materials are piezo electrical ones and Carbon Nano-Tubes (CNT).

Aluminum is used for special ship constructions that require taking into account the following aspects material property and behavior, structural design, joining aluminum to steel, fire protections, reliability, and risk assessment. An aluminum boat is usually built by cutting metal—sheet, plate, and extrusions—to shape and welding them together to achieve a watertight shell that is reinforced on the inside by aluminum framing, chine bars, and stringers. The deck of the boat needs to be designed to create a watertight seal.

It should be mentioned that if a hull is built of steel, building the superstructure from aluminum obviously saves top weight, which is extremely important for stability and handling under extreme conditions. If steel and aluminum are used together in construction of a boat, these dissimilar metals need to be insulated to prevent galvanic attack of the aluminum, which acts as an anode in electrolytic contact with steel.

One of the most commonly used methods of weight reduction is achieved by a combination of different materials, where the dominant role is played by the application of composite materials. When changing the material, it is necessary to test the geometry and technology of manufacture and joining. The material properties largely depend on the operating temperature. Therefore, the area of the operating temperature of the product is a very important factor for the choice of materials. The next passage will be devoted to several practical examples of different materials application in lightweight design projects.

Smaller vessels are mostly built with lightweight materials in order to achieve desired high-speed performance or transportability objectives. Larger ships use lightweight materials for structures above the main deck.

This has the effect of reducing ship weight and improving stability without diminishing overall hull girder stiffness.

In addition to the basic requirement to perform the given duty and to meet the given requirements, in lightweight structures it is important to take into consideration the following requirements: safety/reliability, adaptability to manufacture, suitability for control, suitability for assembling, maintainability, the impact on the environment, recycling etc. For example, shipbuilding with composite materials requires detailed process descriptions and a rigorous quality assurance program, because composite structures require a number of individual materials, each of which is subject to its own supply challenges.

High-strength low-alloy steels are low carbon, copper precipitation strengthened ones, whose strength and toughness are equivalent to those of HY steels, and that can be easily welded without preheating. HSLA steels can ensure a higher resistance when subject to sudden impact loads, like underwater explosions. On the other hand, there is no practical advantage in using such steels when cyclic loads are dominant as fatigue behavior is not dependent on the steel used but on the geometry of structural details and the quality of production.

The potential for lightweighting the primary hull structure of very large ships is limited by stiffness and fatigue considerations. For example, the largest aluminum ship is 127 m and the largest composite ship is 75 m. These milestones will likely be surpassed as more at-sea experience with lightweight vehicles accumulates.

Lightweight materials are especially attractive for novel hull forms, such as multihulls, surface effect ships (SES) and hovercrafts. These ships require lightweight hulls yet have more surface area than their monohull counterparts. Ships that achieve high-speed performance by planning or other means of dynamic support must be lightweight in order to perform as designed.

Deckhouses are the first place ship designers look for lightweighting opportunities. This is because deckhouse structure is not expected to contribute to hull girder strength and stiffness, thus making it possible to use a lower modulus material.

Conclusion. Society of the 21st century is characterized by great challenges to the building of the urban environment and infrastructure. With the rapid growth of the world population and production of consumer goods is growing rapidly. This leads to rapid consumption of resources of the country primarily energy and material resources. There is a need of reducing the use of these resources, and one way is the use of new materials and lightweight design. The most influential factors related to lightweight



design are constructions structures, new materials, technology development, joining and assembly.

These desired attributes are balanced against cost constraints and survivability. Smaller vessels are often built entirely with lightweight materials in order to achieve desired high-speed performance or transportability objectives. Larger ships tend to use lightweight materials for structures above the main deck. This has the effect of reducing ship weight and improving stability without diminishing overall hull girder stiffness.

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**Аннотация.** Целью данной работы является обсуждение облегченной конструкции в судостроении. Фокус сделан на концепт создания облегченной (легковесной) конструкции. Различные материалы, используемые в судостроении в подобных проектах, описаны. Данная статья показывает возможные преимущества при использовании того или иного материала в облегченной конструкции различных судовых структур или корпуса судна. Статья также перечисляет проекты, которые уже разработаны и воплощены. Значимость дальнейшего развития этого концепта указана.

**Ключевые слова:** облегченный, конструкция, судостроение, практическое преимущество, корпус.

**Summary.** The aim of this work is to discuss the lightweight design in shipbuilding. The focus on the concept of the lightweight design is made. The different materials used in shipbuilding for this design are described. This article shows the possible benefits from using this or that material in lightweight design for different structures or the ship's hull. It also states the projects that have been developed and carried out. The significance of the further development of this concept is stated.

**Key words:** lightweight, design, shipbuilding, practical advantage, hull.

## SHIPS IN FUTURE

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Speed is everywhere and in everything at the first place, the same situation will be tomorrow, in a year – in future. Speed is a characteristic of the time, and the time is money, as you know. You can feel it nowadays. For modern ships and for ships of future, water is the worst enemy, as well as travelers frightened by oceans choose fast ships on which they can get where the soul wants. The first ship of future has already been created and made several sea expeditions. It is something between the ship and the plane and its name is «*Sea Arrow*». This is an amazing and fast enough ship, that is capable to overcome large waves but for now at short distances.

The vessel *Earthrace* can develop an excellent speed due to her external appearance and design features. Earthrise's hull is capable to sink into waves but the most striking characteristic of this vessel is her stability. The hull of the ship is made by carbon fiber. Another feature of the vessel "Earthrace" is her economical propulsion system, which operates on biofuel.



This vessel will need only one container with such fuel which is made of soybean oil and reduces the release of harmful carbon dioxide to 75 percent. Such ships will become a common phenomenon in future; moreover, experiments are already under way on a developed unit that receives biofuel from seaweed what is also will benefit the environmental recovery.

Many years ago as well as today a lot of ships are traveling over world's oceans and face the problem of wave resistance. Scientists rethought

about the hull design and its capabilities. The result is the ship with a new, atypical form which stands out among all other ships because it does not have a hull.

The vessel of future «*Proteus*» can overcome high waves easily. She adapts free to any waves and marine environment so she does not have to overcome their resistance.

This concept is called Wave Adaptive Modular vessel (WAM-V). The first creator of such futuristic vessel was the Italian oceanographer Ugo Cont who works at the Institute of Marine Research in North Carolina. The cost of his pilot project was about \$ 1.5 million.



"*Proteus*" is a completely new type of vessel all working parts of which slightly touch the water surface penetrating into waves arising on her way. She adapts to the structure of waves due to parts flexibility.

The ship of future "*Proteus*" is made of several types of light and durable materials: titanium, aluminum and reinforced fabrics.

A module hanging above the water can be replaced depending on the functions or purposes of this vessel. "*Proteus*" can be transformed from a craft to transport people to a ship for transporting any goods. One of the advantages of such reincarnation is the speed. Transformation does not take much time, effort or resources.

Maneuvering and control over such futuristic vessels like "*Proteus*" remind an arcade of video games. Two joystick controllers make the control easy and enjoyable. The vessel also easily reaches the shore and is moored without any difficulties. Now "*Proteus*" is used for whale watching and underwater reconnaissance. Such concept destroys the stereotypes about existing water moving resources and it may eventually interest cruise ship or other types of vessels' owners.



**Technical ship's particulars "*Proteus*":** length - 30 m; draught - 12 tons; power propulsion plant - two diesel engines with a capacity of 355 bhp. The range of voyage is up to 5000 miles. The maximum speed is 70 knots.

**High-speed cargo and passenger ships of the future**

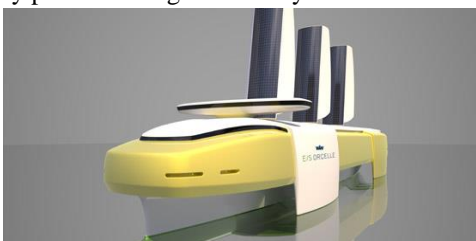
We live in the age of water transport development - it's nice to perceive. But the time taken to handle goods is spent irrationally. One story is to manage a small ship and the other one is an ocean ship with cargo. The company "Hydro Lance Corporation" has developed new different types of vessels which will include some important aspects in future - speed of movement and speed of loading, transformation and unloading cargo on board.

These ships will be able to cross the Atlantic Ocean without any problems in three days. Their design will allow them to develop their speed in all weather conditions since they do not experience wave impacts due to the hull design.



But in the world of freight traffic there is only one important question – time duration of cargo operations. Per one hour about 30 containers are handled. Self-moving tapes and other modern devices will help to load multi-tonnage containers filled with goods in few minutes. The extensive area of trails will not take a long time to unload and load motor vehicles. Also in ports or container terminals cranes will no longer be needed. These unique ships of future will evenly place the cargoes directly on the deck and in holds.

To embark passengers on board seaports will not be needed at all, since the design of cargo-and-passenger ships of future will allow them to approach freely of shores.



The world consumes millions of liters of fuel per day. Prices are unstable for petroleum products and supplies of these minerals are not endless too so engineers are constantly looking for alternative sources of energy. Huge cargo ships annually throw millions of cubic meters of carbon dioxide into the atmosphere causing great damage to the atmosphere and bringing the glaciers melting at poles. Some scientists believe that the development of shipbuilding goes the wrong way.

The engineers of the Swedish shipping company «Wallenius Wilhelmsen» were given complete freedom of action resulting in a cargo ship that uses the energy from the environment. "*E / S Orcelle*" is a new concept in the field of cargo ships of future. The futuristic cargo ship is the

first of this kind which uses just three alternative sources of energy - sun, wind and waves.

On her eight decks, which size is equal to 14 football fields (85,000 sq. M.) up to 10,000 cars will be placed. Three cargo decks will be adjustable in height and allow to transport cargo of heavy weight.

The creators of the long distance ship of future "*E / S Orcelle*" were inspired by the conqueror of distant expanses - albatross. 90 per cent of the source of their energy is believed to be nature. Like this bird the project of the amazing vessel "*E / S Orcelle*" will use the energy of the environment to reduce her own energy consumption.



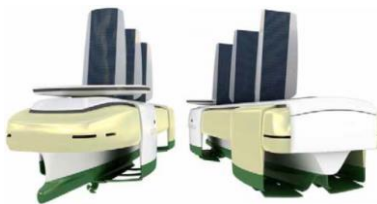
Untypical hull design and lack of traditional propellers and rudders will eliminate one of the main threats of the world ocean - ballast water.

The first alternative source on the ship of future will be solar energy. Three huge sails consisting of photovoltaic panels in windless weather will collect solar energy which then will be converted into electrical one for instant use or conservation.

The second alternative source of the ship of future "*E / S Orcelle*" will be wave energy. The cargo ship will be equipped with twelve devices - "fins" which can transform the kinetic energy of whirlpools into a mechanical one and then into electricity.

And finally the fuel cells. This technology is becoming more widespread today and developing rapidly. About half of electricity consumed by the ship of the future *E / S Orcelle* will be generated by fuel cells. They will combine the most common chemical elements on our planet - hydrogen and oxygen for electrical energy production for propulsion motors of the ship and also generate electricity for other consumers on board.

The leaders of "Wallenius Wilhelmsen" believe that shipping companies should do more to develop new technical solutions for shipping. The material costs of building a future ship will not be cheap and will be much more than the construction of a standard cargo ship required \$ 46 million but in the long term with the development of applied technologies costs will become less and naturally cost-effective. In the company "Wallenius Wilhelmsen" the ship for cars transportation "*E / S Orcelle*" is



planned to be built in 2025.

**Technical ship's particulars of the future «E / S Orcelle»:** Length - 250 m; Width - 50 m; Height - 40 m; Draft - 9 m; Displacement - 21000 tons; Maximum speed is 27 knots.

I would like to believe that trends and solutions already received will be applied to existing vessels in the near future. Having found connection with ocean humanity will change the world. We will conquer the waves having received energy from nature itself and we will descend into the depths to find and research new territories.

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4. Future Ships in Development URL: <https://www.youtube.com/watch?v=bZcLOf6f1TQ/> 10 CRAZY Future SHIPS In Development

**Аннотация.** Статья посвящена будущему поколению судов различного назначения. Автор попытался описать конструкцию этих кораблей, показать их необычность и отличительные особенности. Он также дал информацию о корабле. В данной работе подчеркивается, что важнейшими особенностями судов в будущем являются скорость, экономичность, а также необычный внешний вид и комфорт.

**Ключевые слова:** скоростная характеристика, преодоление больших волн, корабельная устойчивость, соевое масло, атипичная форма судов, преодоление волнового сопротивления, футуристический сосуд, трансформация.

**Summary.** This article is about future generation of ships of different purposes. The author tried to describe the design of these ships, show their unusualness and distinctive features. He also gave ship's particulars. This paper emphasizes that the most important features of ships in future are speed, cost-effectiveness as well as unusual appearance and comfort.

**Keywords:** speed characteristic, to overcome large waves, ship's stability, soybean oil, atypical form of ships, to overcome waves resistance, futuristic vessel, to be transformed.

## THE PROBLEM OF ICING ON SHIPS

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Due to the increase of vessel traffic and raising volume of operation in the remote Arctic and Antarctic areas significant challenges are being encountered with respect to safety and reliability. It concerns commercial vessels, such as oil tankers, container ships, fishing vessels, tourism cruises, research, and offshore exploration vessels and icebreakers. Because of the presence of oil and gas in the region shipping operations in the Barents Sea have increased significantly. There are established routes from the Norwegian territory in Svalbard and the Russian Arctic terminals in Arkhangelsk, Murmansk, Vitino and Varandey.

The problem of icing on ships and the consequent danger for the ship's safety is the reason for making this report. The aim is to discuss this problem, state the main reasons of its occurrence and tell about the de-icing methods and technologies.

Various accidents during shipping operations in the Arctic Ocean have been reported [1]. The causes of these accidents are highlighted as human factors and the climatic conditions. In 1989, when the oil tanker Exxon Valdez ran aground off the coast of Alaska and caused a significant oil spill, it generated a widespread discussion about safety standards. The following rule was proposed by Germany and was included in the International Convention for the Safety of Life at Sea in 2004: 'Ships intended for service in polar waters should have suitable ice strengthening for polar conditions in accordance with the rules of a recognized classification society'. Also the IMO introduced guidelines for shipping operations in the Arctic Ocean in 2002. Although these guidelines give required provisions, which are important regarding maritime safety, they should only be considered as the first step. Its shortcomings were concerned with icing on ships: ice protection and removal.

To improve the existing IMO instruments, the International Code for Ships Operating in Polar Waters (Polar Code) released an updated version in 2015. The provisions concerning ice accretion are stated in the chapters of the polar code. The chapter about subdivision and stability states that the icing allowance is 30kg/m<sup>2</sup> on the exposed weather decks/gangways. This allowance reduces to 7.5kg/m<sup>2</sup> for the projected lateral area of each side of the ship above the water plane. It is stated that the ice accretion should be monitored, and adequate measures should be taken for its mitigation. It also states that ships operating in areas and during periods where ice accretion is likely to occur shall be designed to minimize the accretion of ice, and equipped with such means for removing ice as may require, for example electrical and pneumatic devices, and/or special tools such as axes or wooden clubs for removing ice from bulwarks, rails and erections.

The icing on ships and offshore structures is caused by atmospheric sources and sea spray. The sea spray is the main source of icing and is generated by the wave collisions, the breaking of waves due to strong winds and bursting bubbles that float upon the waves [2]. Heavy ice accretion poses a threat to the stability of ships and offshore structures by shifting their centre of gravity.

Ice accretion sources include freezing rain, supercooled fog and snow. In the case of freezing rain, water droplets are cooled below freezing point (0°C) in the atmosphere and freeze upon impact with a structure. This ice accretion phenomenon tends to produce glaze ice, which is clear and has a density of approximately 900kg/m<sup>3</sup> [2]. Atmospheric ice accretion is also caused by supercooled fog water droplets that freeze upon impact with the structure. This ice accretion phenomenon tends to produce hard and soft rime ice, depending on how quickly a water droplet freezes before the next impinging droplet. Generally, rime ice varies in density between 200 and 900kg/m<sup>3</sup>. In addition, snow over the structure under particular weather conditions may be compacted to produce white ice. This ice has a density of approximately 300–600kg/m<sup>3</sup> [2]. In all of the above cases, the variation in ice types and densities is also influenced by atmospheric temperature and wind conditions.

The phenomenon of sea spray ice accretion begins to occur after the generation of sea spray, when the air temperature drops below the freezing point of seawater (approximately -2°C). As shown in Figure 1, the airborne liquid water droplets carried by cold air impinge on the structure, creating ice followed by a liquid water film. With the growth of ice thickness, sea salt precipitates, creating pure ice and brine pockets. The liquid water film



drains as run-off water under the gravity. In such cases, the majority of water upon impact is drained off from the icing surface and only a small amount is entrapped; this process of ice growth on a structure is known as wet growth (Fig.1).

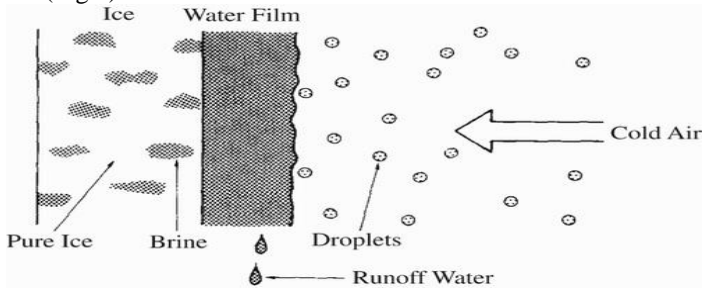


Figure 1. Sea spray icing accretion phenomenon.

The phenomenon of sea spray and atmospheric icing depends on the droplet sizes from their respective sources. The sources of sea spray contain water droplets that are produced by sea waves colliding with marine structures, as well as the breaking of waves due to strong winds. The combined effect of both could also cause sea spray generation. Droplets and snow from atmospheric sources created over the sea can also contribute to sea spray icing. Similarly, fog, precipitation and clouds can cause pure atmospheric icing, which contains different droplet sizes. In addition, wind characteristics (speed and direction) also play a vital role in the size of sea spray droplets.

It should be mentioned that the way in which sea spray covers a ship depends on her structure, overall size and weather conditions. The ship structure includes mainly the bow, bulbous bow, anchor, deck, superstructure, funnel, propeller and stern. The design of the ship's bow plays a vital role in the generation of sea spray, because it interacts with the waves upon collision and creates the spray. In addition, the rate of spray is also influenced by the overall size and height of the superstructure above the deck. Smaller vessels are exposed to spray more regularly, compared to larger vessels because of their lower freeboard and increased motion [2].

It is hard to predict the level of icing on marine platforms with variable structure and heading, even under similar meteorological conditions. Different methodologies have been adopted to predict the amount of ice accretion on the surface under the influence of sea spray and atmospheric conditions. The approaches for predicting include empirical and theoretical models. The empirical models focus on the intensity of the ice accretion caused by the freezing sea spray, and their output is the rate of ice accretion along with the qualitative classes of ice severity, such as no ice, ice,

moderate, severe and extreme. Most theoretical ice accretion models for sea spray predict the icing rate on static structures as a function of air temperature and wind speed with considering the size and the complexity of the structures at sea. The empirical and theoretical models were improved over a period of time by the addition of parameters not considered in earlier models [3].

After having discussed the ice accretion prediction models some de-icing or anti-icing methods should be discussed. Superstructure sea spray icing and atmospheric icing originating from snow, freezing rain, freezing drizzle, rime, sleet and frost cause a risk to the safety of the offshore platform and to ships' operations. In the 1980s, 10–12 ships were lost annually worldwide as a result of superstructure icing, whereas in the 2000s there were 5–7 ships [4]. Advanced navigational equipment and improved weather forecasting on ships have provided considerable assistance in cold climate navigation, enabling ships to navigate around storms or decide to remain in port, for instance in intense polar lows. Situations can arise, in which the severe weather conditions cannot be avoided and ships have to encounter icing events. In this scenario, maneuvering ships to minimize the icing impact could be one option. In such cases, some researchers suggest avoiding the sea spray by heading downwind or maneuvering the ship downwind of land mass, such as island, coastline or peninsula. This could cause a relatively lesser wave–ship collision to produce minimum sea spray icing on the ship's superstructure. Apart from the maneuvering strategy to avoid ice, ships and other platforms operating in cold regions can be protected by the many de-icing and anti-icing methods that reduce ice accretion. Most of these technologies have evolved from the aviation, electric and transportation industries and, among them, those adaptable to the marine environment have been identified for use [4].

Ship sections can also be prioritized in different categories and anti-/de-iced with respect to their implication for the safety standards. Det Norske Veritas classifies ship equipment and parts in two major categories, the first of which includes navigation, propulsion, anchorage, steering and life-saving equipment. It is recommended that these items are anti-iced under all conditions during operation. The second category includes superstructure, deck, railings, helipad and cargo deck area. Equipment in this category can be de-iced within 4–6h after ice accretion [3]. Engineer Research and Development Center has reviewed almost 15 classes of de-icing and anti-icing technologies for marine platforms, most of which involve chemical, thermal and mechanical methods. Of course, some are in the development phase.

Chemical de-icing and anti-icing methods are widely used in different fields and new/improved chemical agents are continuously being developed and tested. Besides anti-/de-icing chemical development, challenges exist to address environmental protection and metal corrosion. There are chemicals that can be applied before the icing event to make the surface resistant to icing. Other chemicals are applied after the icing event to break and melt the ice. Anti-/de-icing chemical agents include several chlorides, formates and acetates, namely sodium and calcium chlorides, magnesium chloride, calcium magnesium acetate, potassium acetate, potassium formate, sodium acetate and sodium formate.

The application of these chemicals is based on their suitability for the specific area, while also taking into account their disadvantages. For instance, sodium chloride has corrosive properties and tends to be ineffective at lower temperatures, and some of these chemicals absorb the moisture and leave behind the residue, which is slippery and can be hazardous in terms of walking.

The anti-/de-icing chemicals could be sprayed on the ship's decks and walkways by means of portable sprayers or lawn fertiliser-type spreaders. The areas of the ship lying below the main deck in the ice accretion zone and lattice structures may need more dedicated and fixed-type spray mechanisms. By using this method of de-icing the environmental protection measures should be considered and applied.

Thermal methods involve applying heat to the surface internally or externally by various means, such as electrical wiring, heated pipes, hot water and hot air. In order to anti-ice the surface, heat is applied in advance to limit the ice accretion, whereas, to de-ice the surface, sufficient heat is applied to melt the ice. Applying the heat to initiate the melting process normally consumes a lot of energy, at least. Despite this, under certain circumstances, it is a suitable approach when other means are not feasible. For example, hot water is more effective for short-term ice prevention on ships and other applications, where even a small amount of ice accumulation is operationally critical.

Different parts of the ship's structure can be de-iced with electrothermal systems. Older versions of these systems had elements embedded in the substrate of the heaters, and more heat was wasted in the embedded substrate before it was transferred to the icing surface. It is suggested that this method be implemented on the support structures under the main deck, piping sections, air intakes, bulkheads, hatches, including the parts of the moon pool and cellar deck areas of the ship. One form of the electrothermal system is electrical heat tracing, which can be an effective

method for marine platforms. Electrical heat tracing has its pros and cons, based on its specific type and application. These are illustrated in Table 1.

**Table 1. Electrical heat trace types: advantages and limitations**

Electrical heat trace type	Advantages	Limitations
Self-regulating (self-limiting)	Easy to design, flexible, cut to length, easy to terminate, unconditional T-rating	Selective to high-temperature exposure (generally <420°F/215°C), start-up currents must be considered
Power-limiting	Easy to design, flexible, cut to length, built-in cold lead, high-temperature exposure to 500°F/260°C	Higher runaway temperatures, T-rating determined by application, more care during circuit fabrication
Parallel (zone) constant watt	Easy to design, flexible, cut to length, built-in cold lead, high-temperature exposure to 500°F/260°C	Higher temperature requires control, T-rating determined by application, more care during circuit fabrication
Flexible series (constant watt)	Flexible, easy to monitor, can be field fabricated, high-temperature exposure to 500°F/260°C	Difficult to design, circuit length affects power output (shorter lengths may require transformer), T-rating determined by application, more care during circuit fabrication
Mineral insulated (MI) series heaters	Durable and rugged sheath, easy to monitor current, custom-fabricated heaters, highest T-ratings to 1100°F/593°C	Difficult to design, MgO dielectric susceptible to moisture, field measurements required for factory fabrication (long lead times), shorter length may require transformer), T-rating determined by application

Manual de-icing techniques are the traditional, primitive practices used on ships. They include the forceful application of handheld tools/devices to the ice accreted structures. Shovels, wooden bats and hammers are common devices, but they can only be applied to the accessible parts of ships, and these methods can expose the workers to dangerous environmental conditions in a cold climate and can damage the equipment or wear off

paints and coatings. That's why nowadays the ship owners try to apply more advanced methods despite of their high expense.

Ice can be detected using a variety of technologies, which sense the presence of ice based on its mass, electrical and thermal properties. These devices are specific to the operational environment and the area of application, e.g. point detection, event occurrence, mass, rate, etc. All the possible methods for ice detection can be categorized in direct and indirect ones. The four ice detection technologies are worth to be mentioned. They include imaging, remote sensing, conformal and probe detection methods.

Remote imaging is similar to a photograph taken by a camera, but the image is of radar waves, not visible light. It should be highlighted that remote imaging ice detection could be implemented in areas of ships and offshore platforms, such as decks, stairs and open working areas.

Ice detectors employing the microwave analysis use image-processing techniques to determine the ice distribution. These techniques are insufficient for measuring ice rate and icing load. However, they are useful for producing geographically based icing distribution and analysis. Electrical impedance and weight measurement-based icing equipment is more specialized and focused on ice mass. Some prototypes, using active infrared techniques, are available for the ice rate analysis. There is room for an icing system capable of measuring the instantaneous icing rate and thickness, along with the ice type. This could provide an advantage in anticipating the ice accretion and load based on true ice types [3].

**Conclusion.** The number of operations in cold regions due to oil exploration and other interests has increased. Severe ice accretion during marine operations is caused by sea spray and atmospheric factors. Sea spray icing is a major contributor to icing on ships and offshore structures. The main source of sea spray icing is the spray generated by collisions between the structure and waves.

Theoretical and experimental models for predicting the icing rate deal with the specific set of parameters in a particular environment. They are difficult to generalize for all sorts of shipping platforms and sea conditions. It is suggested that no single methodology of anti-icing or de-icing can satisfy the entire ice protection requirements of a ship or an offshore platform.

The ice accretion in cold regions is complex and more localized. It requires reliable ice detection to support anti-icing and de-icing systems. Ice detection techniques work on various physical properties, such as mass, LWC, electrical and thermal properties. Some of these properties are used in commercially available ice detectors, while work to develop more reliable ice detectors is ongoing.

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**Аннотация.** Целью данной работы является обсуждение явления «обледенение» во время морских операций. Фокус сделан на два основных источника обледенения, которые объяснены. Данная статья также обсуждает доступные модели прогнозирования образования льда на судах и морских сооружениях. Показаны также технологии предотвращения обледенения, которые можно применять на судах, работающих в районах с низкими температурами. Значимость определения степени обледенения указана. Кратко представлены технологии определения степени образования льда.

**Ключевые слова:** обледенение, источник, технология предотвращения образования льда, методы прогнозирования обледенения, морские условия.

**Summary.** The aim of this work is to discuss icing in marine operations. The focus on two main sources of icing is made. Atmospheric and sea spray icing are explained. This article discusses the available ice accretion prediction models on ships and offshore structures. It also shows the anti-icing or de-icing technologies that can be implemented on ships operating in cold climate regions. The significance of ice detection is stated. A brief review of various ice detection technologies is provided.

**Key words:** icing, source, anti-icing technology, ice accretion methods, sea conditions.

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Memristor theory was formulated by Leon Chua in 1971. Chua strongly believed that a fourth device existed to provide conceptual symmetry with the resistor, inductor, and capacitor. This symmetry follows from the description of basic passive circuit elements as defined by a relation between two of the four fundamental circuit variables. A device linking charge and flux (themselves defined as time integrals of current and voltage), which would be the memristor, was still hypothetical at the time. However, it would not be until thirty-seven years later, on April 30, 2008, that a team at HP Labs led by the scientist R. Stanley Williams would announce the discovery of a switching memristor. Based on a thin film of titanium dioxide, it has been presented as an approximately ideal device. The reason that the memristor is radically different from the other fundamental circuit elements is that, unlike them, it carries a memory of its “past”. When you turn off the voltage to the circuit, the memristor still remembers how much was applied before and for how long. That is an effect that can't be duplicated by any circuit combination of resistors, capacitors, and inductors, which is why the memristor qualifies as a fundamental circuit element [1, p.69].

Memristor, the contraction of “memory resistor”, is a passive device that provides a functional relation between charge and flux. It is defined as a two-terminal circuit element in which the flux between the two terminals is a function of the amount of electric charge that has passed through the device. Memristor is not an energy-storage element. A memristor is said to be charge-controlled if the relation between flux and charge is expressed as a function of electric charge and it is said to be flux-controlled if the relation between flux and charge is expressed as a function of the flux linkage [1, p.10].

Memristance as a property of the memristor. When the charge flows in one direction through a circuit, the resistance of the memristor increases, and its resistance decreases when the charge flows in the opposite direction in the circuit. If the applied voltage is turned off, thus stopping the flow of

charge, the memristor remembers the last resistance that it had. When the flow of charge is started again, the resistance of the circuit will be what it was when it was last active [4, p.87].

A resistor is analogous to a pipe through which water flows. The pressure of water at the input of the pipe is analogous to the voltage, and water is analogous to electric charge. The rate of flow of water through the pipe is similar to electric current. If the pipe has a larger diameter, the flow of water through the pipe is faster, just like more current flows through resistor with a small value of resistance. An analogy for a memristor is a different kind of pipe, the diameter of which expands or shrinks depending on the direction of the water flowing through it. The diameter of the pipe increases when the water flows in one direction, enabling water to flow faster, and the diameter of the pipe decreases when the water flows in the opposite direction, thus slowing down the water flow. If no water is let into the pipe, the pipe will retain its most recent diameter until the water is turned back on. Thus, the pipe “remembers” the amount of the water that has flowed through it.

#### **Application of memristors:**

##### **1. Nano-scale nature.**

The main objective in the electronic chip design is to move computing beyond the physical and fiscal limits of conventional silicon chips. For decades, increases in chip performance have come about largely by putting more and more transistors on a circuit. Higher densities, however, increase the problems of heat generation and defects and affect the basic physics of the devices. Instead of increasing the number of transistors on a circuit, we could create a hybrid circuit with fewer transistors but with the addition of memristors which could add functionality. Alternately, memristors could turn on more energy-efficient high-density circuits. Memristors were not observed before because the effect depends on atomic-scale movements, they only emerged on the nanoscale of William’s devices. Information can be written into the material as the resistance state of the memristor in a few nanoseconds using few picojoules of energy. Once written, memory stays written even when the power is shut down [3, p.10].

##### **2. Replacement of flash memory.**

The important potential use of memristor is a powerful replacement for flash memory, the kind used in applications that require quick writing and rewriting capabilities, such as in cameras and USB flash. Like flash memory, memristor memory can only be written 10,000 times or so before the constant atomic movements within the device causes it to break down. It is possible to improve the durability of memristors [2, p.12].

##### **3. Replacement for D-RAM**



Computers using conventional D-RAM lack the ability to retain information once they are turned off. When power is restored to a D-RAM-based computer, a slow, energy-consuming "boot-up" process is necessary to retrieve data stored on a magnetic disk. The reason computers have to be rebooted every time they are turned on is that their logic circuits are incapable of holding their bits after the power is shut down. But because a memristor can remember voltages, a memristor-driven computer would allegedly never need a reboot.

#### 4. Brain-like systems

As for the human brain-like characteristics, Memristor technology could one day lead to computer systems that can remember and associate patterns in a way similar to how people do. This could be used to substantially improve facial recognition technology or to provide more complex biometric recognition systems that could more effectively restrict access to personal information. These pattern-matching capabilities could enable appliances that learn from experience and computers that can make decisions. It is observed that the complex electrical response of synapses to the ebb and flow of potassium and sodium ions across the membranes of each cell which allows the synapses to alter their response according to the frequency and strength of the signals. We can conclude that it is similar to the response a memristor would produce [2, p.15].

Nanotechnology is fast emerging, and nanoscale devices automatically bring in the memristive functions. Thus, memristors might revolutionize the 21st century as radically as the transistor in the 20th century.

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**Аннотация.** Мемристор — это пассивный элемент в микроэлектронике, который может изменять свое сопротивление в зависимости от протекающего через него тока (интеграла тока при работе). Его можно использовать как устройство хранения или обработки данных следующего поколения, более быстрого, чем все известные процессоры. Таким образом, это самое большое открытие в строительстве и технической эксплуатации судов, поскольку это

приводит нас к созданию автономных судов без единого человека на борту. Мемристоры могут революционизировать 21-й век так же радикально, как транзисторы - 20-й век.

**Ключевые слова.** Мемристор, электромагнитный, резистор, радиоинженерия, электроинженерия.

**Summary.** Memristor is a passive element in microelectronics which can change its resistance, depending on the current flowing through it (the current integral during operation). It can be used in many different solutions like building next generation data storage or processor that would be faster than any processors known nowadays. Thus, it is the greatest discovery in shipbuilding and technical exploitation, because it leads us to building self-working ships without even one sailor on board. Memristors could revolutionize the 21st century as radically as the transistor in the 20th century.

**Keywords.** Memristor, electromagnetic, resistor, radioengineering, electroengineering.

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## FLOATING CITIES OF THE FUTURE

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One of the biggest challenges facing the world today is climate change. Greenhouse effect and melting glaciers for a long time not a myth and not even the near future, but our true reality. The level of the world's oceans rises rapidly, which entails the gradual withdrawal of coastal areas under water. If in the early 90-ies of the last century, the annual growth was only 2.2 mm, at the end of 2014, this figure reached 3.3 mm. The worst thing is that it continues to grow. Humanity, one way or another, is forced to think. One of the most interesting solutions was floating cities.

The aim of the article is to discuss this solution, floating cities. The main focus will be on the concept of the floating cities. The solving greenhouse effect consequences and the features of new floating cities are also discussed. It should be made for observing the pros and cons of this idea.

In many European countries have long been successfully used floating houses, which literally balance on the water. And many exerts, developers and builders try to do their best in creating their own projects in this sphere. The main purpose is to get possible solution for preventing overcrowding and climate change on land. Every week, a three million new people are moving to live in a city. That's equivalent to the current population of San Diego transplanting themselves into urban areas every seven days. It is almost a new Moscow or Rio de Janeiro every month [1].

At the very beginning of this work we will speak about negative attitude to this idea, because it could make our research useless. All innovative technologies involve great investments, humanity should move further. But now it is about disadvantages.

Despite the progressive idea of floating Islands, many people are negative. The construction of powerful ultra-modern cities will inevitably require enormous financial costs. Consequently, rich businessmen will build eco-friendly cities for billionaires, and ordinary people risk to remain with their problems. While the construction of floating cities is under development due to the impressive cost. According to preliminary calculations, the price of one standard apartment in the metropolis on the water will start from 800 thousand dollars. At the moment, investors doubt the payback of the enterprise, because only very wealthy people can afford such a pleasure [2]. Some projects are so good that they should be discussed.



Figure 1. The project of a floating city.

According to the idea of floating cities in one project, the city will consist of hexagon modules, which will be connected with each other and with the land by means of special road tunnels. Floating City is designed for life and work, it is designed to create additional living space in a densely populated state. It should be highlighted that it is still a virtual city and most of it is under water, not over it.

The French architects have created an unusual "Town of Photosynthesis". Feature of the project-complete safety for the environment. The secret in the use of innovative technology based on algae biochemistry. Special elements are mounted in the facades of houses to convert carbon into oxygen. Such a luxurious metropolis with high-rise skyscrapers is ideal for location on the coast near the cities of Asia and the United States.

The project "City silt of the lake" was designed by students from France especially for the Aswan dam and the surrounding land in Egypt, which was seriously damaged as a result of creating an artificial pond. The proposed system is able to reclaim the muddy earth. The metropolis consists of modular components, comfortably installed next to the dams. It can change the position depending on the change of water level in the reservoir.

Japanese experts from Shimizu Corporation have planned a fully Autonomous floating island, which has enough space for one million people. It has adequate energy resources, food and strong protection against natural disasters. Skyscrapers are needed not only for apartments and offices, but also accommodate agricultural land.

Another French Studio Vincent Callebaut Architects has distinguished itself through its futuristic project. Designers and architects have come up with how to use it to restore settlements that in the future will fall to the bottom of the oceans and seas. The design of the floating island resembles a Lily flower in appearance. In one such town there is enough space for 50 thousand people. Segments can be combined with each other, connected to the land or allowed to swim freely on the world ocean.

When in 2010-2013 the city of Haiti was destroyed by a series of powerful earthquakes, a talented architect from the UK named Kevin Schopfer invented a network of islets on the water. More than 60 per cent of the land on them can be used for growing crops, and the remaining areas are suitable for the construction of light industry enterprises. Such Islands helpers, Haitians typhoons and hurricanes would be terrible.

All the above-mentioned projects are at the stage of development. But the concept of the floating city should be explained in details. One major advantage of it is that urban planners would be able to start from scratch. Connections, cables and buildings could all be constructed on a certain pattern, in a contrast to those attractive historic towns where regulations require streets and buildings to be preserved in their traditional form [3].

The platforms of the future floating city will be equipped to generate their own power from renewable and sustainable energy sources. Of course, first cities will not be self-sufficient and should be engaged in trade in order to supply themselves. If the cities were over the water, they should have modular structure, storm resistance, cost savings for residents at a certain

level of comfort and convenience. “Smart city” will have resource management optimization.

The idea is to build large raft-like structures that can act as floating foundations for buildings, roads, utilities and parkland. While land-based cities are static and cannot be easily remodeled without demolishing buildings, floating cities could be repeatedly remolded according to the seasons or population changes.

Now the projects that are real should be discussed, of course, these are not floating cities or “smart cities”. But they should be described for getting know what features of new technology are used nowadays, and people will benefit from such aspects.

In Singapore, for example, 25% of the city is built on reclaimed land, while 20% of Tokyo is built on artificial islands built out into the sea. The authorities in Dubai have built entire luxury complexes on artificial islands while huge tracts of Holland have been reclaimed from the North Sea with an intricate system of levees and dykes that have been protecting urban areas from flooding for centuries[4].

Most people that are sceptical to the project of the floating cities, but not for money matters, speak about several drawbacks of this idea. For example, if the city is at open sea, where waves can reach 20m (65ft) high and storms can rage for days, how people will survive on this floating structure. It could be possible to build a floating structure at sea that will not be subject to the harsh ocean environment. If the city is built and there half of the population may be sea sick. That is not going to be economically viable. People could hardly like living like that.

Instead, it seems the future of floating cities may lie somewhat closer to the land. The possible project is to build a high-tech hub of floating islands in the protected waters. And there is one “smart city”, that will be in a Tahitian lagoon in French Polynesia by 2020. More than 1,000 people have already expressed interest in living there, but at \$15 million per module – with perhaps 11 modules providing homes for 200-300 citizens. life there will not be cheap.

Conclusion. The real value of floating cities may lie in providing more space for the world’s overcrowded urban centres to expand into. It seems likely that some form of hybrid city will emerge where we combine the benefits of land-based and floating cities by expanding into nearby waters. As technology improves to help us weather the ups and downs of life on water, these may then start to extend further out into the sea. Such solutions may be the only way human civilization can cope with growing populations and changing climates in the future. What is clear to us is that hope definitely floats.

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**Аннотация.** Целью данной работы является обсуждение «города на плаву». Фокус сделан на концепт «умного города». Некоторые технические характеристики этой новой технологии объяснены. Данная статья также обсуждает доступные на данный момент проекты. Подчеркнуто, что один из них уже разработан, другой только на чертеже. Статья показывает те аспекты, которые в настоящее время используются и от которых проект плавучего города выиграет. Значимость решения для преодоления таких проблем, как перенаселение и парниковый эффект указано.

**Ключевые слова:** плавучий город, умный город, море, берег.

**Summary.** The aim of this work is to discuss the floating cities. The focus on the concept of “smart city” is made. Some features of this new technology are explained. This article discusses the available projects on this day. It is highlighted which one has been developed, and that is only a sketch. It also shows those aspects that are used nowadays and from which the floating city project will benefit. The significance of solution to solve such problems as overcrowding and greenhouse effect is stated.

**Key words:** floating city, smart city, resident, sea, coast.

## **CAUSES OF ACCIDENTS AT SEA. IMPROVING NAVIGATIONAL SAFETY**

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Shipping is the safest and most environmentally friendly form of commercial transportation. Security commitment has long been an important issue in all deep sea navigations of ships. Shipping was among the top five industries that applied international safety standards. Due to its inherently international nature, the safety of shipping is regulated by various UN offices, in particular the International Maritime Organization (IMO), which has developed an integrated system for regulating global maritime security [1].

Safety of navigation is the main property of any vessel and is considered the most important condition for the possibility of efficient operation. The huge overall dimensions of ships, the increase in speed, the increase in traffic on the sea routes, navigation in storm weather conditions and other reasons make the problem of navigation safety most important in assessing the state and development of maritime transport. Despite the dynamics of the development of methods and technical means of ensuring safety, over 200 large ships at sea suffer shipwreck. Every year 2 000 people die, millions of tons of cargo are lost, oil products and other pollutants are spilt due to accidents at sea.

Causes of accident at sea. Such organizations as IMO, UN, MMK, IPU created documents regulating the safety of navigation. The basic are the following: STCW 78/95, SOLAS-74/78, COLREG-72, ISM Code, UN Convention on the maritime law in 1982, and others [1].

Safety of navigation includes two main components: navigational (security from landing of a stranded ship to collision with other forces) and technical (fire safety, safety from explosions, safety associated with the failure of technical systems, propulsors and other vital mechanisms).

The level of safety is determined by the reliability of the vessel and the skill level of the crew and the organization of its work, including the proper implementation of the laws of navigation and the effective use of

technology, communications, means and methods of navigation.

Analyzing the statistics of marine accidents, the main causes accidents on maritime transport can be considered:

- errors of the boatmaster's staff in the management of the ship;
- low qualification of crew members;
- wear of machinery and equipment of ships;
- inattention of shipowners to safety issues at sea.

The progress of scientific and economic development of human society has led to an improvement in the quality of ships and its technical and navigational equipment. This factor played an important role in reducing the number of groundings and ground contacts. The overall losses of ships of the world fleet have decreased significantly. Whereas in the 1960s and 1970s, the average annual loss of vessels was 349 vessels, during the decade (1982 - 1991) the losses of the world fleet (vessels over 500 tons) averaged 177 vessels per year [5]. Statistics of the three years of the second half of the 1990s (1996 - 1998) show that ship losses continue to decrease: the average annual number of ship losses in these three years is 101. Every year on the ships of the world fleet an average of 250 - 300 accidents occur [2].

Analysis of the causes of the collision showed that 59% of the total number of collisions occurred due to psychological reasons. At the same time, three psychological types of boatmasters who have committed collisions are distinguished: self-confident type, frivolous and not understanding the degree of danger [3].

**Chart 1. The causes of collisions at sea**

Causes	Rate
Errors due to a sense of self-confidence	17.5%
Frivolous underestimation of the danger of the situation	39.5%
Misunderstanding of the degree of danger	43%

According to the statistics of 1997, there were 294 ships of various purposes and displacement, including four Russian vessels. From this list, 146 vessels had navigation accidents of varying severity. Thus, a large number of navigational accidents (over 65%) confirms the urgency of the problem of improving the accuracy and reliability of navigation [4].



**Fig.1** The 5 most common incidents, according to VesselsValue.com [5].



Thus, the main direction of ensuring security at the sea was and still is an increase in the reliability of sea-going vessels, the improvement of technical means of navigation and the improvement of seaworthiness of ships, reducing the risk of fires. At present, the technical design of vessels does not always correspond to the regional requirements for safe and efficient navigation, which leads to a significant reducing of the time for efficient operation of ships in complex ice and storm conditions. The human factor also remains one of the main factors affecting the safety of marine ships.

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**Аннотация.** Безопасность судоходства является актуальной проблемой современности. Состояние безопасности морского транспорта оценивается как потенциальная чрезвычайная ситуация. В мировой практике особое внимание уделяется причине аварий при эксплуатации судна. На основе материалов исследований транспортных происшествий сделан акцент на "человеческом факторе" как одном из важнейших, даны конкретные рекомендации по

совершенствованию судоходства. В данной статье дается анализ статистики причин кораблекрушения, человеческого фактора, остающегося основной причиной, и способов минимизации ущерба для судов и экипажа.

**Ключевые слова:** безопасность на море, человеческий фактор, статистика, эффективная эксплуатация судов, инциденты в море.

**Summary.** Safety of navigation is an actual problem nowadays. The security status of sea transport is estimated as a potential emergency. In world practice particular attention is paid to the cause of accidents during the operation of vessel. Based on the materials of transport accidents investigations, emphasis is made on the "human factor" as one of the most important, and specific recommendations are given for improving navigation. This article gives the analysis of the statistics of the shipwreck causes, human factor remaining the major cause, and the ways to minimize the damage to the vessels and the crew.

**Key words:** maritime safety, human factor, statistics, efficient operation of ships, incidents at sea.

## SECTION 9: PSYCHOLOGY AND PEDAGOGY



UDC 378

### ESTHETIC EDUCATION OF YOUNG PEOPLE

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*To develop man's capacity for feeling and thinking,  
in the first place it is necessary to develop him aesthetically.*

*Friedrich Schiller*

At the present stage of society development, the main goal of the national education system is to prepare well-educated citizens, capable of acting creatively and efficiently for the benefit of the society. To achieve this, the more important role is given to the development of human creativity and human's ability to transform the surrounding life. In this regard, the role of aesthetic education and upbringing is growing. It involves the formation of aesthetic judgments, tastes, and improvement of the inner emotional world of a young person.

The problems of aesthetic education are paid with special attention not only in school and preschool institutions, but also in higher educational institutions. These are the universities that form fully developed and spiritually rich young personalities along with providing them with professional training.

Today modern society makes great demand of students, where the aesthetic component comes to the fore, in which the educational space has a dominant influence on the process of harmonization of life, the aesthetics of which is its essence.

Theoretical questions of aesthetic education and the specific characteristics of aesthetic education of young people of different ages were researched by such scientists as S. Kostyuk, I. Zyazyun, V. Peredery, A.

Kirichuk, A. Semashko, S. Anichkin, M. Yves, A. Melik-Pashayev, L. Pechko, etc. In vocational training in the university: E. Vyatkovskaya, L. Ruvinsky, L. Spirin, N. Shmyreva, etc. M. Arapov, E. Grishin, V. Mozgoth and others were working on identification of common creative and aesthetic abilities.

The system of aesthetic education at university should use all aesthetic phenomena of reality which are concentrated in art, fiction and related to nature, social and working activities as well as people's lifestyles and relationships. Artistic education becomes particularly important, where the means of art are used as an educational principle. They form and develop special abilities in the following areas: visual, musical, vocal, choreographic, theatrical, decorative, applied arts and others. Here an important aspect lies in the upbringing and development of such qualities and abilities that will not only enable young people to achieve success in any activity, including professional, at present and in future but will also contribute to creativity and perception of the beauty of the surrounding world.

Many scientific researchers pay attention to the question on how to restructure the contents of higher education on the basis of interaction of various forms of apprehension of this world. Thus, scientists rightfully emphasize that “science and art unite in a high impulse to harmonize relations between man and nature“. Foreign experts review the problem of modernization of higher education in the context of aestheticizing the pedagogical process – addition of an aesthetic component to each academic discipline, integration of common definitions, use of art as the basis of general education [1].

Aesthetic education is a well-aimed process of formation a human's aesthetic attitude to reality. The system of aesthetic education includes the awakening and development of a sense of the beautiful and the sublime. Therefore person understands the world and expresses his relation to what surrounds him [2].

At university studying different disciplines without reliance on aesthetic development of student's personality is impossible to bring up a competent, comprehensively developed specialist who possesses not only professional skills and knowledge, but also the ability to work, and with creative approach, who values beauty in life and beauty of the world around him. The formation of such a person is the main goal of aesthetic education of universities. This goal is not simple, its achievement requires implementation of multiple tasks. In her work “Peculiarities of the organization of aesthetic education at university“ researcher I. A. Kovaleva. [3] notes that:

Firstly, it is necessary to create and constantly update the base of elementary aesthetic knowledge and impressions. This will contribute to the desire for creative development in the field of various arts (music, literature, dancing ...)

Secondly, to make a student wish not only to get acquainted with some art at a general educational level, but also to experience it emotionally and evaluate from his aesthetic perception point of view. Only after that there is an opportunity to fully enjoy the perfection of the work. In this case, we can talk about “aesthetic admiration“, which actually evokes emotional experience and forms a critical aesthetic judgment – evaluation itself.

Thirdly, to form a student's aesthetic creative ability. Nowadays to know and to be able to admire and appreciate is not enough for a person. It is necessary to self-realise, actively participate in the creation of beauty in art, work, social life.

Fourthly, and adjustment of aesthetic consciousness is necessary today. This task has to be solved considering psychological features of a person, basing on aesthetic perception, taste and ideal. These three categories are closely interrelated. Perception is the beginning of aesthetic attitude to ambient reality, processes of forming an idea and taste depend on a brilliance and depth of perception. Aesthetic taste is being shaped in a person within many years, and during the whole life it can be changed. It is aesthetic taste that determines a committed and purposeful activity of a person, and leads to the achievement of optimal results. Gained life experience also influence the choice of aesthetic ideal and its replacement. These factors are necessary to be taken into consideration while executing goals and tasks of aesthetic education at University [3].

Teaching future specialists at University has to be directed to identifying a particular aesthetic potential while teaching every single discipline. Building an aesthetic culture in students through lectures has to be systematic and methodological. A teacher can find a niche, in every topic of any subject, that must be filled out with some knowledge of a perfect in the field of music, painting, literature.

Socially educational work at University is it comprehended and purposeful nurturance of a person, according to peculiarities of groups, goals and organization, that makes it reach. Competitive identity of a student is the final game of socially educated work.

Leading role in students' rearing lies on University's faculty. A lecturer has always been an upbringing, but today breeding can and should be clear not only as a simultaneous transmission of experience from elders to youth, but also an interaction and cooperation between teachers and their students in the field of their common learning and extra-curricular activities.

One of the most important subjects of breeding is the overall University's atmosphere. That is why, and educational environment is formed by efforts of the entire staff.

The process of aesthetic education of future specialists has to be based on six parameters of creativity, highlighted by J. Guilford, which constitute a strong foundation of such mindset. The ability to find problems, generalize a significant number of ideas, react on irritants unusually, improve subject and solve problems analyzing and synthesizing them. Scientists admit, that thanks to the perception of artistic creation develops every components of creative thinking in a person. Impacting the intellect through the world of senses, that is how M. Nechaev claims, that "the art influences a social practice, and that is why, the notion of creative thinking is included into coordinate system of professionally essential identity characteristics together with features of technological expertise and depth of teacher's inner world" [4, c. 57].

The main way to organize diverse creative activities for students is various forms of extra-curricular work, such as: youth theaters, clubs of interests, KVN, arts and crafts areas, competitions, olympics etc. Within the process of such work students get closer to creativity and make their first steps in art. Results can take the form of performance, concerts' arrangements, exhibitions, presentations etc.

The level of mannerliness and aesthetic culture is changed in accordance with individual development, formation and satisfaction of aesthetic needs, tastes and interests of youth. The forming of aesthetic attitude and activity in all its forms (work, communication, religion, environment) contributes to the development of the inner world, that leads to a comprehensive development of a person.

Evaluation of effectiveness of a socially educated work is rather a difficult task, as it is impossible to choose absolute criteria. What is more, results of educational work are said to be realized within many years. For example, you can assess the level of aesthetic mannerliness with the help of several criteria, included into one of the three groups: psychological (gloat, worry, judgement), pedagogical (appraisal of an ideal, taste) and social (interests and aesthetic development needs).

So, aesthetic education of students is a complicated pedagogical process, that consists of a precise interaction between students and a teacher, the core of which is the formation of creative and fully-developed student's identity.

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**Аннотация:** В статье рассматриваются вопросы эстетического воспитания студентов в ВУЗе, как сложный педагогический процесс, где есть четкое взаимодействие студента и преподавателя, в основе которого лежит формирование творческой и всесторонне развитой личности студента. Выявляется уровень эстетической культуры в зависимости от индивидуального развития, формирования и удовлетворения эстетических потребностей, интересов и вкусов молодежи, а так же формирование эстетического отношения и эстетической деятельности во всех проявлениях, которое способствует развитию духовного мира студента.

**Ключевые слова:** эстетическое воспитание, воспитание, студенческая молодёжь, искусство, эстетическая культура.

**Summary:** The article deals with a question of aesthetic education at higher educational institutions as a complex pedagogical process, that based on the precise interaction between students and a teacher, the core of which lies on a transmission of a creative and comprehensively developed personality of a student. The level of aesthetic culture is determined, depending on an individual development, formation and satisfaction of aesthetic needs, interests and tastes of youth, as well as building an aesthetic attitude and activity in all its forms, that maintains in the development of the inner world of a student.

**Keywords:** aesthetic education, education, students, youth, art, aesthetic culture.

UDC 159.9

## **DEPRESSION: THE MAIN FACTORS OF FORMATION**

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Is depression a disease or a condition? Medicine characterizes depression with the following symptoms: depressed mood, loss of interest in family, everyday affairs, insomnia, early awakening in the morning or, on the contrary, excessively long sleep; irritability and anxiety, fatigue and loss of strength; lack of appetite and weight loss or sometimes, conversely, overeating and weight gain; inability to concentrate and make a decision; decline in libido; a sense of futility and guilt, a sense of hopelessness and helplessness, frequent bouts of crying; thought of suicide [1].

Depression is experienced as a feeling of deep sorrow, hopelessness, helplessness, worthlessness, loss of control over oneself, low self — esteem, as well as a decrease in interest in the necessary daily affairs—personal hygiene, food intake, official and school duties, communication with people. There are thoughts about suicide and attempts to commit it. Children suffering from depression are often non-social, aggressive, have difficulties in school and complain unduly about their physical condition. Symptoms of depression do not depend on age, they can be mild and severe, lasting from several weeks to many years [2].

Here are some factors that appear to increase a person's vulnerability to depression [3].

Genetic predisposition. In depression is a certain hereditary element: when one of the identical twins falls ill, in two cases, his brother or sister will also fall into depression. One study showed a significant thinning of the cerebral cortex in families with depression, which scientists suggest may indicate inherited genetic vulnerability [3].

Complicated relationships with parents at an early age. Every day we learn more and more about how experiences in early childhood affect the development of the brain and thus lead to problems in adulthood. If the primary caregiver is not set up on the same emotional wave with the child — perhaps because of his or her own depression—the child may never develop a healthy self — esteem and a sense that he or she is worthy of love. He may lose the ability to trust others or to control his impulses [3].

Poor interpersonal skills. Shyness and social phobia are very much related to depression. The feeling of embarrassment or embarrassment in social situations leads to the fact that a person begins to avoid them, it makes him even more withdraw, and then negative thoughts can bite the patient to death [3].



Lack of social support. Many people suffering from depression are isolated from the world not only by depression, but also by life circumstances. Often these are the only children in the family, people working in positions with minimal social connections, divorced, rejected by the family, living in the backwoods. Others are married but without love, and relationships alienate and hurt. If a person has no one to rely on in difficult times, he feels the loneliness and danger [3].

Unstable self-esteem. If the rejection really hurt you and erodes your sense of self, and the good brings only temporary pleasure and weak is a characteristic of depression [3].

Depression may well be seen as a response to stress. With stress, we face almost constantly, solving certain problems. For example, a bad mark on the exam or not passing the test causes stress (strong negative emotions) to a greater or lesser extent.

After the stress response occurs (protective) reaction, and often a state of depression. In response to each of the small (minor) stress the negative nature of the organism responsible for adequate depression. But little stress is even useful to the body, they train him. As greater the stress, as stronger (deeper) and longer is the state of depression [1].

It is possible to make an unambiguous conclusion that the cause of any depression (depression) is stress. Depression-a non-specific reaction of the body to stress. A small depression in low stress - a common condition of the body, which the body generally copes on its own. Strong, deep depression - this is a disease, and without the help of a doctor can not do [1].

Depression is the result of the impact of current stress on the vulnerable person. Stress is enough to a man has transgressed the invisible line and got into a vicious circle of depression resulting from repressed thoughts, self-destructive behavior, guilt and shame, neurochemical changes.

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**Аннотация:** Статья посвящена вопросам изучения феномена депрессии в психологической науке и его симптоматике. В работе рассмотрен вопрос причины возникновения депрессии по Ю.В.

Хмелевскому. Выявлены основные признаки депрессии и факторы, ее вызывающие.

**Ключевые слова:** депрессия, взаимоотношения, поддержка, самооценка, организм, симптом.

**Summary.** The article examines the phenomenon of depression in psychological science and its symptoms. We have identified the concepts of the question of the causes of depression by J.V. Chmielewsky. The main signs of depression and the factors causing it are revealed.

**Keywords:** depression, relationships, support, self-esteem, prone to depression, the body, symptom.

UDC 159.95

## **THE PHENOMENON OF MOTIVATION IN RUSSIAN PSYCHOLOGY**

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One of the fundamental problems of psychology is motivation. The study of this phenomenon has been engaged in many scientists, both in foreign and native psychology for many centuries. There are internal mechanisms for inducing a person to act.

The purpose of the article is to study the theoretical analysis of the problem of motivation in Russian psychology.

The motive (lat. moveo 'move') — is a generalized image (vision) of material or ideal objects of value for the person that defines the direction of its activities, the achievement of which acts as a point of activity. The motive is presented to the subject in the form of specific experiences, characterized by either positive emotions from the expectation of achieving these objects, or negative, caused by the incompleteness of this provision. For the realization of the motive requires an inside job.

V.N. Myasishchev was considered the motive as the relationship of the individual [1]. Motive is nothing more than an expression of the relation to the object of action.

According to D.N. Uznadze, the essence of motivation is to find and find an action that corresponds to the basic and entrenched in human life setup. D. N. Uznadze wrote that the motive is a consideration that forced the subject to commit this act, this need, to meet which this behavior was considered appropriate [3].

S. L. Rubinshtein for the first time began to consider motives in connection with specific activities [1]. Under the motive he understood to a greater or lesser extent adequate conscious incentive. Objects and objects only give rise to motives, but they are not.

A.N. Leontiev also believes that the function of the motive can find even intermediate means, one of such phenomena – the shift of the motive to the goal. The reverse process is also possible, namely generalization of motive factors [2].

Thus, under motives involve three interrelated sides of the same phenomenon:

1. internal motivations related to the need to satisfy physical;
2. social and spiritual needs of the person, their concrete embodiment;
3. a person's awareness of the reasons for his purposeful activity.

Motivation is called the processes of 'action', the implementation of these motives, that activity of the person which goes and is regulated by motives. Motives thus act as the reasons, motivation — as a consequence, as process of activity of the person, his activity and behavior.

Motivation of achievement is one of the types of motivational activity, which is associated with the need of a person to achieve only success and avoid failure. The presence of motivation of achievement can be judged by the behavior of the person.

All depends on the characteristics of the task and situation. In different activities, the level of motivation will be different.

According to its manifestations and functions in the regulation of behavior motivating factors can be divided into three relatively independent classes [1]:

- (a) needs and instincts as sources of activity;
- b) motives as the reasons defining the choice of certain acts of behavior;
- c) emotions, subjective experiences, attitudes as mechanisms of regulation of behavior dynamics.

According to the theory of B.S. Bratus, there are three levels of motivation [1]:

1. personal which is determined by the quality of semantic relations, shared the meaning and purpose of his life, toward others and yourself;
2. individual psychological assessment of which depends on a person's

ability to build adequate ways of realization of semantic aspirations;

3. psycho physiological: determined by the characteristics of the internal, cerebral, neurophysiologic organization of acts of mental activity.

Thus, in Russian psychology motivation is viewed as a complex multi-level regulator of human life, its behavior and activities. Native scientists consider motivation from the point of view of activity approach. The concepts of motivation are similar and complement each other: from internal determinants to external activities (act, action).

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**Аннотация.** В данной статье рассматривается феномен мотивации в рамках отечественной психологии. Выделены понятия мотива с точки зрения деятельностного подхода.

Ключевые слова: мотив, деятельность, мотивация, потребность.

**Summary.** The article deals with the phenomenon of motivation in the domestic psychology. The concepts of motive from the point of view of activity approach are allocated.

**Key words:** motive, activity, motivation, need.

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## ANALYSIS OF SOME EDUCATION PROBLEMS OF THE LATE 20TH AND EARLY 21ST CENTURY

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One of the priorities of the state policy in the development of education at the present stage is national education integration into the world educational area. In the history of higher education development in Russia, the period of the late XX – early XXI century was very intense. The rational model of education is replaced by the synergetic one with all its diversity and variability. These changes affected the teacher, his/her personality, views and opinions, as well as pedagogical skills.

Multiannual experience of traditional higher education is undoubtedly important for the development of modern education, but in the XXI century priorities changed in education. So, the traditional model, which was reduced to knowledge and skills transferring, has lost its relevance and potential [1, p. 5].

The traditional education system was focused on the subject rather than on the student's identity. It was reproductive, dominated by verbal teaching methods, authoritarian style of communication and strict regulation of the educational process. At this stage of higher education development the accents of pedagogical activity are changing: preference is given to dialogue learning. More and more possibilities are provided for self-decision-making, content choice, ways of teaching and behavior. The period of late XX – early XXI centuries can be divided into three stages.

The beginning of the first stage can be considered as the adoption of the decree of President Boris Yeltsin in 1991 "About priority measures for the development of education in the USSR" [3]. The decree was aimed at improving the education system and the material well-being of teachers. Today it is obvious that this decree has a declarative character.

The second phase is characterized by significant developments, such as the educational reform, which began in 1994. In accordance with it, the State program "About urgent measures to support the education system", the creation of unitary Ministry of education, the Academy of Pedagogical Sciences, the opening of new universities were developed and approved. Ideological courses were eliminated from the curricula of the Universities, the introduction of testing began. The flow of target means to these funds has been irregular and inadequate. A positive factor was the strengthening of integration of higher education and secondary special education.

During this period, the normative and legal field of education is formed. The features of university education of this period include: pragmatism devotion, absolutization of the status and role of purely market relations, underestimation of the ethical principle in the social life and relations of the teacher and students. Shortcomings in higher education of this period became:

- the increase in the number of private universities, which do not always satisfy to indicators quality;
- opportunities limitation for professional development of teaching staff;
- excessive administration;
- compulsion to attend classes in the context of declaration of increased attention to the independent work of students [2, p. 740];
- haste and subjectivity in educational practice.

The III Stage comprises the beginning of the XXI century (continues to this day). This period is characterized by emergence and wide introduction of information technologies, computer systems, laser communication, biotechnologies. Since 1999, many universities have been implementing a new concept of higher education, which included changes in three areas: content (what to learn), structure (sequence of presentation of educational material) and technology (how to conduct training). Substantive characteristic are: humanization, individualization, socialization, fundamentalization, internationalization.

The beginning of the XXI century is a period of information technology. There is a task of reorientation of the contents of training from the general memorization of material for ability training to self-learning, constructive activity, development of cognitive activity and creative potential of the personality. The role of independent work is growing.

Federal law № 232-FZ of 24.10.2007 [5] introduced a level structure of higher professional education: the first level corresponds to the bachelor's degree – the first academic degree awarded to students after completion of the basic program of study; the second level– master's degree – the second (higher) academic degree, the initial academic degree received by the student after completion of the master's degree.

Separate state educational standards and independent final certification have been developed for each level. The Federal state educational standard of the third generation focuses on the formation of graduate competencies, on what a student should know at the end of higher education. In 2005 there was a tendency of growth of financing of education.

On 3-rd of September, 2005, the Cabinet of Ministers adopted the concept of the state programme for the development of education for 2006-2010, aimed at increasing the level of education. Prospects of higher education of the Russian Federation for the next decade are formulated in the Federal target program of development of education for 2016-2020 [4]. According to this program one should perform the following steps:

- to complete the optimization of the network of universities in accordance with the needs of society;
- educational institutions should become centers for the development of scientific and educational activities, in particular certain areas of fundamental scientific research;
- along with budget financing, it is planned to use about 70% of the funds of industry innovation funds.

Steps are being taken to strengthen the continuity of the school – university system. In particular, on behalf of Russian President Vladimir Putin, on the basis of the leading educational institutions of the Republic of

Crimea and Sevastopol, centers for identifying and supporting children with special abilities are being opened.

It should be noted that the experience of developed countries can be essential for national education, but it is impossible to use only their experience. The versatility and diversity of the modern system of knowledge, comprehension of new research methods may be effective for further development of national higher education. The Russian educational system requires, in our opinion, an "educational breakthrough" after we are able to analyze all the acquired knowledge, approaches and previous experience.

Changing the philosophy of teaching, a new look at the educational process and its organization will lead to a high quality of higher education.

Thus, the main trends to solve problems of higher education development of the late XX - early XXI century include: improving the efficiency of forms and methods of education; introduction of innovations and technical means of education, which have a positive impact on the professional level of training of both the teaching staff and students; involvement of students in research, cooperation. It should be noted that there are many problems and difficulties in the system of higher education in Russia and problems are raised and discussed some of them in this article. Therefore, these issues require further research and study.

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**Аннотация.** Многолетний опыт традиционной высшей школы имеет большое значение для развития современного образования, но в XXI веке в образовании меняются приоритеты. В статье анализируется развитие образования конца 20 – начала 21 века в российской высшей школе. В работе этот период условно разделен на три этапа. Проведен анализ некоторых проблем, возникших на каждом из рассматриваемых этапов. Выделены перспективные направления и основные тенденции развития отечественного высшего образования.

**Ключевые слова:** развитие, динамика, перспективы, образование, высшая школа.

**Summary.** Multiannual experience in traditional higher education is of great importance for the development of modern education, but education changed priorities in the XXI century. The article analyzes the education development of the late 20th – early 21st century in the Russian higher school. This period is conventionally divided into three stages in the work. The analysis of some problems of considered stages is carried out. The perspective directions and the main tendencies of domestic higher education development are stated.

**Keywords:** development, dynamics, perspectives, education, higher school.

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## **INTELLECTUAL GAMES IN THE UNIVERSITY AS A MEANS OF EDUCATION, TRAINING AND DEVELOPMENT OF THE STUDENT'S PERSONALITY**

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The teaching is for the student the leading type of activity, within the framework of which his development is carried out as an individual, professional and member of society. The degree of involvement of a student in educational activity is determined by the extent to which the didactic system provides him with a didactic system for manifesting his own personal activity in terms of goal-setting and goal-realization. And this, in turn, depends on the content and conditions of the organization of the



educational process in the university.

The student's activity is organized in a specific form of educational and cognitive activity. The main goal of the exercise is the formation of future professional activity. The educational business game is one of the options that are suitable for solving this problem [1].

By the term "game" is meant meaningful activity, i.e. a set of meaningful actions united by the unity of the motive [2, p. 474].

In turn, the motive is an incentive, an excuse for action [2, p. 838]. And as described in Rubinstein, the game is an expression of a certain relation of the individual to the surrounding reality [3].

The problems of teaching with the use of the game were dealt with by such well-known teachers as V.A. Sukhomlinsky, L.S. Vygotsky, K.D. Ushinsky, A.S. Makarenko. In our time these problems are handled by V.V. Abramenkova, V.T. Kudryavtsev and many other teachers.

The game, as an activity, contains huge opportunities for the development of the personality of the student and his preparation for professional activities. Games allow you to develop your thinking abilities, get to know yourself better, acquire new knowledge, and work out interpersonal interactions. The game is characterized by a high degree of tension and high significance for the participants, high interest and, as a result, a high degree of experience of participants in the events occurring in the game. Deep immersion in the event allows participants in the game to better understand and reflect new knowledge and skills. That is why in some universities, gaming methods of teaching are actively used [4, p.3].

Soviet teacher V.A. Sukhomlinsky stressed that "the game is a huge bright window through which a life-giving stream of ideas, concepts about the surrounding world is poured into the spiritual world. The game is a spark that ignites the spark of inquisitiveness and curiosity. ... she accustoms a person to those physical and mental efforts that are necessary for work "[5].

L.V. Abakumova article notes the importance of conducting training, intellectual and organizational-activity games, since the intellectual game is:

- modeling of educational, industrial, economic and social activities of a person;

- multiple imitation of virtually any situation with the goal of effectively choosing forms and methods for solving the problems that can be solved, which allows finding effective management decisions to activate the educational process in a professional educational institution, maximizing the use of the creative abilities of students;

- the most important means of strengthening cognitive activity of students;

- a functional system in the center of which the search, analytical and creative work of all participants in the game;
- the most effective means of finding an objectively correct management solution in extreme situations, when other methods of solving the problem are unacceptable;
- stimulation of the creative search of students in substantiating the problem, in the argumentation of the ways offered to solve it, in the implementation of the solutions found in practice;
- creation of educational and gaming interaction of participants. Its value is in the collective nature, individual search for the solution of the problem and responsibility of each participant in the game for the results obtained;
- the game atmosphere, which requires from the "potentially passive" of its participants the manifestation of forced activity, and contributes to its maintenance throughout the playing time;
- obtaining alternative results, identifying the conditions for a systematic approach to solving the problem, acquiring a certain practical experience in the search for and justifying the alternative solutions that are being made [6].

Great intellectual opportunities for the development of the individual in the educational process are intellectual games - according to the version of the television games "What? Where? When? ", "Brain-ring", "Your game", etc. They assume the use of erudition, logic, intuition, imagination.

Thus, it can be concluded that holding intellectual games in universities favors the development of such abilities of students as the ability to think logically, receive, process and use various information, solve problems quickly and qualitatively, acquire skills that facilitate the acquisition of new knowledge.

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**Аннотация.** В статье рассматриваются интеллектуальные игры, как неотъемлемая часть учебно-воспитательного процесса студентов.

**Ключевые слова:** дидактическая система, интеллектуальная игра, развитие, учебно-воспитательный процесс, учебно-познавательная деятельность.

**Summary.** The article considers the intellectual games as an integral part of the educational process of students.

**Keywords:** didactic system, intellectual games, development, educational process, educational-cognitive activity.

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## **ATTITUDE TO PHYSICS PRACTICUM ACCORDING TO THE RESULTS OF A SURVEY OF 1-4 YEARS PHYSICS STUDENTS**

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Among the disciplines studied by students-physicists, a special place is occupied by the general physical practicum. Physics students study this discipline during the 1<sup>st</sup> and 2<sup>nd</sup> courses. This helps students to become familiar with the laws of physics and gain important skills in conducting an experiment. As a result of the development of a physical workshop, students study in detail some physical phenomena using physical devices, apply the basic methods of accurate physical measurements. Students learn how to measure the numerical values of physical quantities and compare them with formulas.

To determine the attitude of students to the discipline a survey was conducted in the spring of 2018, as a result of which it is possible to tell about the effectiveness of the classes. The survey was attended by students of 1-4 courses of physics. The questionnaire consisted of 14 main questions, each of which had several sub-items. About 80% of students participated in the survey process, the questions were research ones. It was suggested to express their attitude to the lessons of the general physical practicum. At the

end of the survey it was possible to say the wishes to teachers. The results of the questionnaires are presented below by courses.

It was proposed to estimate the percentage of knowledge gained in physics at each of the courses in the following way (see table 1). From the data given in the table, it is seen that a large proportion of knowledge on physics students receive during the lectures and practicums.

Moreover, it is clear from the statistics that the percentage of knowledge gained at the practicums does not have strong differences depending on the course of study.

Table 1 – The percentage of knowledge gained in physics at each of the courses

On the 1 course	On the 2 course	On the 3 course	On the 4 course
60%- during the lectures	40%- during the lectures	60%- during the lectures	40%- during the lectures
10%- at seminars	20%- at seminars	5%- at seminars	10%- during the lectures
20%- at practicum	30%-at practicum	15%- at practicum	10%-at practicum
10%- individually	20%- individually	20%- individually	10%- individually

2. Students had to indicate the place of the physical practicum in the educational process. We were surprised by the fact that 99% of the surveyed students noted the importance and necessity of discipline while answering this question.

3. Interesting was the following question: "what section of physics with lecture demonstrations do you remember the best of all?" The responses were divided as follows :

Mechanics – 50%, mechanics and molecular physics -45%, electrostatic – 5%.

4. On a question about the teachers' relations to students during the classes of general physical practicums:

– 95% of students said: "always fair and objective»

– 5% noted: "rather fair and objective." These answers show a full contact of a teacher and student, their mutual understanding and successful cooperation.

5. In the survey, students were asked to express their opinion about the " virtual laboratory works" and compare them with the traditional ones. The answers were as follows:

– 98% of answers - "virtual laboratory works" are not so interesting, they are less physical;

- 2% answers - don't see any difference.

This suggests that it is more interesting for students to feel and understand the essence of physical phenomena in practice, to conduct experiments themselves.

6. It should be noted the following test of questionnaire: "Specify the "favorite" laboratory work?" Answers are given below:

- 50% of the students admitted a laboratory work on mechanics;
- 30% of students – laboratory work on molecular physics;
- 20% of students did not answer this question.

7. As an educational and informative question was asked the follow: "What textbooks do you use in preparation for the workshop? The answers were:

- 60% - use of the Internet;
- 25%-the textbook I.V. Savelyeva
- 15% tutorial D.V. Sivuhina

Thus modern students prefer to use the Internet resource , this is due to the vast amount of information posted there: video tutorials , technical sites, online resources .However, the Internet cannot replace textbooks.

In addition, according to students' point of view, it is necessary to increase the number of classroom hours for lectures and laboratory classes. At the end of the survey it was proposed to express the wishes to teachers. They succeeded the such: happiness, health, patience; enjoy your work; inspirations!

As a result of the testing, it can be concluded that the joint work of teachers and students is important and multifaceted. The use of elements of scientific research in physical practice develops cognitive activity of students, provides them with independence and forms an interest in scientific knowledge. Due to the physical practice, students are given the opportunity to learn by experience the main physical phenomena, reproduce them and analyze them correctly. The physical practicum is important to the undergraduate students for various physical processes understanding. Also the creative approach of teachers to students for the development of interest in physics is significant.

**Аннотация.** Описаны результаты анкетирования для определения отношения студентов к физическому практикуму, которое проходило весной 2018 года. Отмечена важность физического практикума в изучении опытным путем основных физических явлений, их анализа. Результаты экспериментального исследования показали, что физический практикум важен студентам младших курсов для лучшего понимания различных физических процессов.

**Ключевые слова:** физика, физический практикум, физические явления, эксперимент.

**Summary.** The results of the survey to determine the attitude of students to the physical practicum are described, which took place in the spring of 2018. The importance of the physical practicum in the experimental study of the main physical phenomena and their analysis is noted. The results of the experimental study showed that physical training is important for junior students to understand the different physical processes.

**Keywords:** physics, physical practice, physical phenomena, experiment.

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## **INTERCULTURAL COMMUNICATION SKILLS FORMATION**

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In connection with the processes of globalization, interest to the problems of intercultural communication has increased significantly. Cross-cultural communication is an adequate mutual understanding of two participants of a communicative act belonging to different national cultures [1].

Today foreign language is increasingly becoming a means of intercultural communication as an indicator of the formation of a specialist's ability to participate effectively in foreign language communication at the intercultural level [2].

In the context of intercultural educational environment for effective communication between representatives of different cultures, the language barrier overcoming is not enough.

The formation of intercultural communication and problems of cultural barriers was considered by O.N. Astafieva, T.G. Grushevitskaya, A.P. Sadokhin, T.N. Saitimova, O.A. Leontovich, S.G. Ter-Minasova. The role of sociocultural factors in improving communication learning and communication between people of different nationalities were considered by T.N. Saitimova, and S.G. Ter-Minasova.

Thus, S.G. Ter-Minasova believes that to know the meaning and rules of grammar is not to use the language actively as a means of communication. It is necessary to know and understand the essence of the studied language. In addition to the meanings and rules of grammar, you need to know: when to say/write, how, where; how this meaning/concept, this subject of thought lives in the reality of the studied language [5].

*The purpose* of this article is to determine the conditions for the effective formation of intercultural communication skills within the educational environment of the university.

The result of establishing contacts between people or the interaction of subjects through various sign systems is communication. Communication is a process of interaction of social entities (individuals, groups), characterized by the exchange of activities, information, experience, abilities, abilities and skills, as well as the results of activities, which is one of the important conditions for the formation and development of society and the individual. At the social level, communication is a necessary condition for the transfer of social experience and cultural heritage from one generation to another.

While mastering a foreign language in high school, the student has to penetrate in a different system of values and life goals and to integrate it into his/her own worldview [4, p. 46].

Language is not only a means, it is also the environment in which a person is formed and lives, which determines a person's life experience.

The efficiency of cross-cultural communication skills formation for providing communication between different cultures is depended on the following factors:

- conditions and culture of communication, rules of etiquette;
- knowledge of non-verbal forms of expression;
- success of overcoming the language barrier;
- taking into account the emotional side, the degree of empathic expression of evaluation perception;
- the cultural barrier overcoming.

Intercultural communication is one in a special context when one participant discovers the cultural difference of another. Communication takes place at three levels: communicative, interactive and perceptual.

The communicative level is a contact through the language and cultural traditions characteristic of a community of people. The result of this level of interaction is mutual understanding between people

Interactive level is a communication that takes into account personal characteristics of people, which leads to certain relationships between people. The situation of communication between two or more people can take different forms: 1) simple presence, 2) exchange of information, 3) joint activity, 4) equal mutual or asymmetric activity and the activity can be of different types: social influence, cooperation, rivalry, manipulation, conflict, etc.

Perceptual level gives an opportunity of mutual knowledge and rapprochement of the people on this rational basis. It is a process of partners

' perception of each other, determining the context of the meeting and depends on emotions, opinions, attitudes, preferences and prejudices.

Perceptual skills are manifested in the ability to manage their perception, "read" the mood of partners in verbal and nonverbal characteristics, to understand the psychological effect of perception and take them into account to reduce its distortion [3].

The perceptive side of communication involves understanding and adequate perception, vision of the partner's image, which is achieved through the mechanisms of "identification-confrontation" and reflection, that is, understanding of what the partners see in the communication of the subject. It will take some time to realize that the impression they give other people may differ significantly from what they expect.

Language knowledge, language barrier overcoming is a necessary condition for the development of intercultural communication skills within the educational environment of the university, since language is one of the most important categories of culture, because it is by means of language that man worldview is formed and expressed.

The main educational principle in cross-cultural communication skills formation is one of dialogue, which allows to join various, not reducible to each other culture, behaviors and activities and value orientations in the thinking and activities of people. The dialogue gives practical meaning to the interaction of cultures and becomes a basis for the development and interaction of cultures [3].

The main educational technologies for the development of intercultural communication skills within the educational environment of the university are: modeling communication (pair and group communication); methods of active learning (discussion, problem lecture); independent creative development of solutions; trainings in active mode (behavioral and personality-oriented trainings); interactive methods (modeling real-life situations, joint problem-solving); Internet technologies (information communication technologies).

The most productive in language barrier overcoming as one of the main obstacles in intercultural communication is Internet with its latest technical developments. Information and communication technologies allow students to engage in authentic intercultural interaction with representatives of the studied culture.

Media sharing and modeling multiplies educational opportunities educational product. Communication connecting to the triad "interactive-multimedia-modeling" expands the range of teaching methods, gives new options for the organization of the educational process.

Thus, the conditions for the effective intercultural communication



skills formation are certain factors considerations that ensure the effectiveness of communication between representatives of different cultures, namely: the conditions and culture of communication, the rules of etiquette; knowledge of non-verbal forms of expression; the success of overcoming the language barrier.

In order to develop intercultural communication skills, it is necessary to support educational technologies while combining the possibilities of the largest number of pedagogical tools. The prospect of further research is a study of the role of the socio-cultural factor in increasing the level of learning communication between people of different nationalities.

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**Аннотация.** В статье рассмотрены основные особенности процесса формирования межкультурной компетенции в рамках профессиональной подготовки. Определены условия эффективного формирования навыков межкультурной коммуникации в рамках образовательной среды вуза. Проанализированы уровни общения и выделены основные образовательные технологии для развития межкультурной компетенции.

**Ключевые слова:** иноязычное общение, культура, культурный барьер.

**Summary.** The formation of intercultural communicative abilities in the process of professional training is studied in the article. The purpose of this article is to determine the conditions of formation of skills of

communication. The main levels of communication and the educational technologies for the development of intercultural competence are highlighted.

**Keywords:** foreign language communication, culture, cultural barrier.

UDC 159.955

## **DEVELOPMENT OF THE CREATIVE POTENTIAL OF STUDENTS-PHYSICISTS**

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In the modern world, often there is a creation of new physical theories, the promotion of hypotheses, the invention of advanced technologies. All these scientists create through a lot of mental work, in which creative potential plays an important role.

Infinitely long and persistently the most outstanding psychologists tried to answer the question of how a person solves new, unusual creative tasks. These include J. Guildford, E. Torrence, E. Bono, G.E. Müller, B.M. Bekhterev, I.P. Pavlov, etc. However, there is still no exact answer to the question about the psychological nature of creativity.

In a large explanatory sociological dictionary, creative potential is defined as "an aspect of the intellect characterized by novelty in thinking and solving problems" [1, p. 317]. A cultural dictionary defines creative potential as "the integral quality of man, the core of his essential forces, expressing the measure of the activity of the individual in the process of his self-realization" [7, p. 378].

The purpose of this article: to reveal the importance of humanitarian education in the development of the creative potential of students-physicists.

Creativity does not come to us from the depths of the universe, along with neutrino rays, piercing the Earth along with all its inhabitants. It must be developed, as well as all other physical, intellectual, moral qualities inherent in man.

At the present stage of modernization of education, the humanities have a great influence on the development of creative potential.

For students of technical specialties, humanitarization involves the development of creative abilities, mastering various ways of interacting with the outside world, ways of obtaining and processing information, becoming familiar with world culture and higher spiritual values.

Humanitarian education is a set of knowledge in the field of social and human sciences and related practical skills and abilities, the most important means of worldview. It is within the walls of the university that "... in the process of humanitarian training, the question of the formation of the student's personality on the basis of universal human values, such as: responsibility for a common cause, free ideological self-determination, general cultural competence, personal self-actualization in culture and life" [9, p.64].

In the work "The Humanization of Natural Science Education as a Means of Its Humanization" V.K. Sukhanova and O.V. Plotnikova's "humanitarianization of education is focused on building an integral picture of the world, on humanizing knowledge, in shaping the worldview as the basis of man's moral responsibility to society and nature" [2, p. 73].

Our reality is that without the knowledge of physics you can no longer step on the step. Physics is the science of the laws of nature, which makes a significant contribution to the system of knowledge about the world around us. V.N. Moshchansky, highlighting the humanitarian aspect in the study of physics in secondary school, noted that "in many schools physics ceased to be experimental and turned into" chalk ". As a result of this transformation, the number of pupils rapidly increases, to whom "physics is not needed." Otherwise, it can not be, because instead of observing the "living" phenomenon, the student receives only conversations about him and "dry" formulas "[3, c. 25]. Because of similar situations in schools and began an active humanitarization. Thanks to her students and physics students will not just memorize the fundamental law of the universal gravitation of Isaac Newton, they can immerse themselves in the era of the scientist's life. The humanities will tell about the history of the experience that led to the discovery of the law, tell about the scientists' contemporaries, give an integral picture of the fundamental law, and not just a dry formula.

The comprehensive development of abilities, on which creative potential develops, is based on culture and art. It is art that develops such invaluable qualities for a student-physicist (as a future specialist), like imagination, fantasy, intuition. Art contributes to the formation of associative, flexible, imaginative thinking. It is difficult to make scientific discoveries without having a sense of beauty and harmony. But all this can be obtained through constant immersion in literature and art. They have a significant influence on the formation of the personality of the future

scientist, on the construction of an integral picture of the world.

The scientific literature describes not only the achievements of scientists, but also their hobbies. So most of the world-famous scientists are fond of art. Probably, this is an integral component in the development of creative potential, which is based on humanitarian education. "Humanitarian education contributes to the emotional development of individuals, and therefore makes them more open to diverse information, activates the activity of their intellect and facilitates the development of any profession" [4, p.19].

If you turn to history, you can find that culture has a beneficial effect on intellectual development and the discovery of the creative potential of scientists. The physicist J. Maxwell was fond of poetry, Niels Bohr wrote articles on philosophy, biology, art and psychology. M. Planck composed poems, showed great interest in literature, art and music. Great played the piano. K.E. Tsiolkovsky combined the talents of an astronomer, a mathematician, a writer, a publicist. A. Einstein played the violin and liked to perform in front of the public. Also, A. Einstein stressed that "narrow specialization turns a scientist into an artisan, that to him works of art give the feeling of the highest happiness" [5, c.3]. Aircraft designer A. S. Yakovlev did not imagine a full-fledged creative life in the field of science and technology without a lively interest in literature and art. He believed that "technical and scientific creativity persistently requires a comprehensive cultural development from the specialist, and music, literature, painting, inspire the creative process" [6, p. 195].

As a research method, the survey used the "Diagnosis of Personal Creativity" (EE Tunik). The survey involved students from 1-5 courses (40 people) in the direction of training "Physics" of Sevastopol State University. The test offered 15 questions

As a result of the test, it was found out that 77.5% of students have a high level of creative potential, the remaining 22.5% - the average. The results showed that physics students have creative potential and the possibility of its realization.

When asked about what to focus on when choosing a profession, most respondents (77.5%) chose the following answer: "The main thing is to be interesting, regardless of payment or prestige. After all, working without pleasure is the most terrible thing. " Answers of this kind give high physicists in physics students, which is what the test results showed.

So, we can conclude that the impact of the humanities education of students-physicists on their creative potential should be based on the construction of an integral picture of the world, on the humanization of knowledge, on the integration of humanitarian and professional education.

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**Аннотация.** В данной статье рассматривается понятие влияния гуманитарного образования на развитие творческого потенциала студентов-физиков. Также рассматривается понятие творческого потенциала.

**Ключевые слова:** Творческий потенциал, гуманитаризация образования, физика, культура, искусство, способности.

**Summary.** In this article the concept of humanitarian education is considered for the development of creative potential of students-physicists. The concept of creative potential is also considered.

**Key words:** Creative potential, humanitarization of education, physics, culture, art, abilities.

## **COMMUNICATIVE AND COGNITIVE APPROACH TO FOREIGN LANGUAGES TEACHING**

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Foreign language is an effective tool for the intellectual potential formation of society, which becomes one of the main resources of the new state development at the present historical stage.

The ability to overcome conflicts due to differences in historical, religious and political cultures is developed by means of language study as a reflection of sociocultural reality and as a phenomenon of culture. The ability to communicate harmoniously not only in our society but also in other societies is developed as well. The ability to communicate belongs to the common culture of mankind.

The main purpose of foreign languages teaching at the university is the development of intercultural competence as an indicator of the formation of a person's ability to participate effectively in foreign language communication at the intercultural level. The objectives are "foreign language education" rather than "foreign language teaching".

In order to achieve purpose in the study of a foreign language, the subject basis of foreign language education should be the communicative sphere. The right goal ensures the quality of education. The problem of the cognitive approach to learning has been studied by S.F. Shatilov, N.V. Bagramova, G.V. Elizarova, A.V. Shipilova etc. Cognitive component approach was considered by E.Y. Severinova and communicative-cognitive aspect was researched by Y.A. Sitnov, K.A. Vinogradov, I.V. Batsenko and others.

The cognitive approach to the study of a foreign language was considered by B.H. Maksudova, S.R. Jalilova, S.E. Nurimova. They prove that communicative and cognitive orientation of the learning process involves attention to individual student as follows: linguistic competence; strategy; discourse; social [5].

The problem of competencies formation included in the concept of "communicative competence" was studied by E.M. Vereshchagin, I.A. Zimnyaya, A.A. Leontyev, V.G. Kostomarov and others. Psychologist L.S. Vigodsky came to the conclusion that all learning "revolves around two processes: awareness and mastery" [1].

B.U. Mataeva states that "the cognitive-communicative approach to learning is the theoretical justification of the communicative method of

teaching foreign languages, that is, the solution of such methodological issues as selection, organization, the sequence of studying language and speech material and the ways of presenting it and training it, taking into account the communicative needs of students of a certain age and educational conditions; on the other hand, from cognitive positions, it provides for the conscious assimilation of knowledge and information of linguistic, regional and cultural-aesthetic character that satisfy and develop cognitive interests and requests for the emerging personality of the student who learns a foreign language at the minimum necessary level” [6, www].

Two sides of the process of foreign language learning are important functions inherent in the human language [2]. Two aspects of language learning – obtaining knowledge about language and getting language knowledge, in the foreign languages methodology are perceived as equally important processes and serve to form an adequate understanding of the linguistic phenomenon, the development of the ability to use this phenomenon in real communication. Therefore, the leading approach to teaching foreign languages in modern conditions is recognized as communicative and cognitive approach [2].

The leading role in the formation of the synthesis of communicative and cognitive approach is played by the communicative principle. Cognitive principle in the framework of foreign language teaching is absolutely necessary, since it is based on the cognitive skills already obtained when mastering the student's native language, which greatly facilitates the process of foreign language mastering.

Due to the communicative and cognitive approach, there was an awareness of the need to take into account the psychological and psycholinguistic problems of students. Teaching methods have a great educational potential, as the independence of thinking and action develops, the desire to manage and evaluate the training which stimulates the spiritual and social development of the individual.

The linguistic personality possesses the developed, formed language picture of the world where the cognitive picture of the world in its material, sign form is fixed and realized [2]. Different linguistic and cultural communities have different cognitive bases which are determined by differences in the language pictures of the world, different membership and classification of the surrounding native speakers of reality. The content of foreign language teaching should include not only linguistic, but also linguistic, socio-cultural, ethno psychological knowledge, but also ways of structuring and representation in the cognitive base.

The conceptual bases of the communicative and cognitive approach to foreign intercultural communication teaching contain the following aspects:

interdisciplinary as the basic didactic principle in teaching foreign language communication; the principle of a level approach to the study of the language functioning as a means of communication, including linguistic, social and cultural levels; the principle of modeling the activity character of foreign intercultural communication, taking into account its three-component structure, covering communication, interaction, perception and mechanisms, ensuring their functioning; the principle of development and improvement of cognitive activity, artistic and scientific pictures of the world in the process of teaching intercultural communication, as the basic principle of development and education of multicultural linguistic personality in professional specialists' training [2].

*Communicative and cognitive techniques.*

We take into account that a technique is a way for a teacher to organize a learner activity. The purpose of communicative techniques is to teach communication [4]. The cognitive approach is based on the cognitive constructivist learning theory which is relied on the premise that learning is an active individual process involving students' participation in knowledge acquisition (empathy).

So, communicative and cognitive techniques can develop in learners productive, receptive and interactive skills that are necessary for effective communication. Activities with listening and reading develop skills of receiving information. Activities with speaking and writing develop in learners skills of producing information. Both can be learner interactive and thus promote communication.

The use of authentic materials and modeling of problem situations of professional orientation, providing both speech and cognitive development of future specialists stimulates a development of the student's linguistic personality [3]. To achieve the goals and objectives of communication skills formation in the framework of communicative and cognitive approach it is necessary to use a special set of exercises.

So, the sequence of tasks aimed at improving receptive and reproductive-productive skills can be as follows:

- language exercises on the observation and perception of the group proposals;
- restoration of logical-semantic connections of microtext;
- speech and communicative tasks, the purpose of which is to reproduce the text and produce their own oral or written statements [3].

Thus, the main content of foreign language teaching in the context of communicative and cognitive approach is determined by the relevant components, including discursive and textual material, speech and language material, language, social and cultural foreign language knowledge. It is



impossible to carry out intercultural communication without getting acquainted with the components of the cognitive base of the national linguistic type.

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**Аннотация.** Рассматриваются образовательные подходы для достижения целезаданности в изучении иностранного языка. Предложен коммуникативно-когнитивный подход к обучению иностранному языку. Описаны коммуникативно-когнитивные технологии обучения, которые развивают у обучающихся продуктивные, рецептивные и интерактивные умения.

**Ключевые слова:** обучение иностранному языку, коммуникативно-когнитивный подход, интерактивные технологии.

**Summary.** The educational technologies to achieve the aim in foreign language learning are discussed. A communicative and cognitive approach to foreign language teaching is proposed. Communicative and cognitive techniques which develop in learners productive, receptive and interactive skills are described.

**Keywords:** foreign language teaching, cognitive-activity, interactive technologies.

## **HARMONIOUS DEVELOPMENT OF PERSONALITY WITHIN THE HUMANISTIC SYSTEM OF VALUES**

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In the space of value dimensions "harmony" appears as the goals of education and the choice of personal development strategies. In today's world, the perception of the goals and means of harmonious development is changing.

Since the values assimilated by the individual in the process of socialization are transmitted to him/her by society, the study of the process of assigning values to the future specialist in the conditions of the educational space of the university is a particularly urgent problem in a situation of serious social changes. The distinctive feature of the values is a revaluation of values, the change of social norms and the crisis of social ideals [1]. Value orientations are reflected in moral ideals, which are the highest manifestation of the target determination of the individual's activity.

The humanization of modern education as a fundamental element of culture is inextricably linked with the ideas about the orientation of the learning process on self-development of the individual, on the optimization of interaction between the individual and society [3]. The humanistic environment of the university is a spiritual space and a significant condition for the spiritual formation of the student's personality as a future specialist. In this environment, spiritual development is manifested in the strengthening of the influence of truly spiritual factors on the behavior of the individual and the growing self-realization of the individual for the benefit of people [2].

The *aim* of this study is to determine the levels of harmony and balance of life in the future specialists in the university, as the ideal of harmonious development of the individual expresses the humanistic system of values. Harmony of internal aspirations and external social requirements is a necessary condition for self-realization in the social environment.

To achieve the goal of the study, the following *tasks* were solved: the literature on the topic of research was studied, unresolved problems in the framework of the study were identified; diagnostic tool for research was selected; stating experiment was conducted and the results were analyzed.

**The methods** of the research. The paper uses the following set of methods aimed at solving the tasks: analysis of scientific literature on the problem of research; methods of collecting empirical data. The drawing test “Harmony and balance of life” was used for diagnostics the levels of harmony and balance of life formation.

Many researchers emphasize the importance of the university stage of personality formation (J. Gilford, B.V Skinner, N.A. Crowder, A. Maslow, P.M. Jacobson). Personal characteristics, motivations, orientation of the individual, intelligence were considered by B.G. Ananiev, N.V. Kuzmina, E.I. Rogov, V.I. Slobodchikov, V.A. Yakunin and others. The importance of studying inner power as the energy of emotions, was emphasized by V.V. Boyko. Inner power shows the following abilities: the ability of self-regulation, i.e. the formation of mental stability, the potential that makes it possible to overcome difficulties; perseverance in achieving success [4].

To determine the level of development of harmony and vitality of the students, we have conducted research work with students of 3-4 courses of the Sevastopol state university. The survey involved students of "Radio Engineering" and "Physics" training directions. Under the terms of the test it was necessary to finish the picture with schematically depicted alarm clock (test-drawings "Your life energy"), giving the picture a complete form and, if necessary, draw details and background, to recreate the situation.

Clock hands: if the hands of the clock are directed up, it means that the life energy is developed and if they are directed down – vital power is needed of filling. As a result of calculations: arrows directed upwards-44%, downwards-18%, up and downwards-38% (see fig.1).

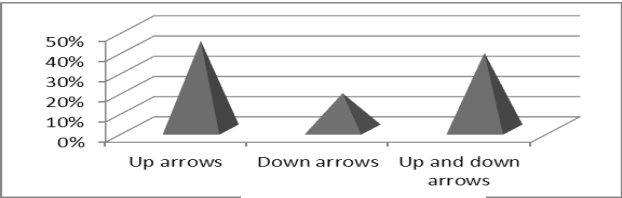


Figure 1. Clock hands directions

Highlight of alarm clock arrows: the brighter the arrows are highlighted, the more energy is required to meet the needs, achieve the goals. Brightly highlighted amount 54%, 46% not highlighted (see fig.2).

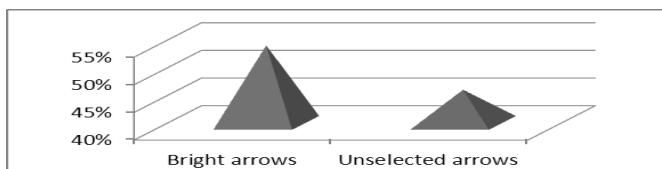


Figure 2. Highlight of alarm clock arrows

Dial: if the numbers are clearly marked on the dial, it indicates that for "recharging" you need to rest. As a result, the highlighted figures – 30%, not highlighted – 70% (see fig.3).

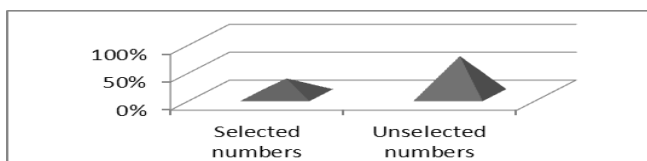


Figure 3. Marking of numbers

Dedicated alarm button: if the bell button on the alarm clock is clearly marked, it shows the need for a change of activity, indifference to business: dedicated – 10%, not highlighted – 90% (Fig.4).

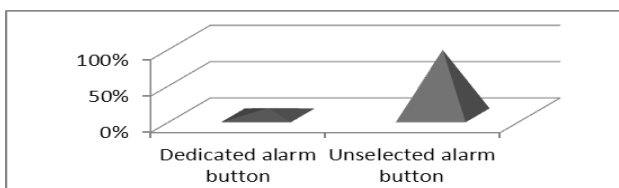


Figure 4. Dedicated alarm button

Alarm case: if it is highlighted, it indicates that the respondent is "recharged" in the field of contacts, while communicating with other people. The selected case was 18% highlighted – 82% (see fig.5).

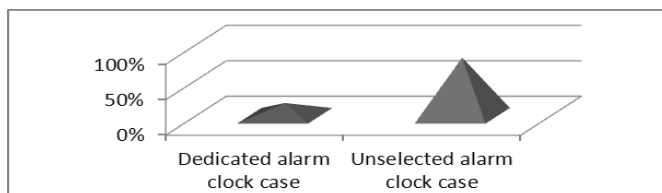


Figure 5. Highlight of alarm case

Alarm clock support: if you pay attention to the support, it shows the need for outdoor rest. A dedicated support amounts 12%, unselected – 88%

indicating unwillingness to recharge with vital energy (see fig.6), the lack of harmonious development of as important part of success in life.

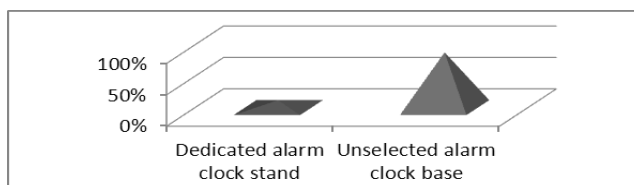


Figure 6. Highlight of alarm clock support

As the results of the study of the level of harmony and vital energy formation in students according to the projective technique "Harmony and balance of life" and the projective technique "Your vital energy" have shown, the level of formation of harmony is low, vital energy is mostly absent. Positive results were in satisfaction of profession choice, interest in activity (90%).

The results of the experiment show that the main characteristics of the harmony of internal aspirations and external social requirements are not formed, but they are necessary for the self-realization of the individual in the social environment, which confirms the need to develop and implement a program of targeted formation of these characteristics.

In conclusion, it should be noted that harmonious development is an important component of life success. The relevance of the problem of harmonious development is due to the growing social need for competitive specialists, since the dynamic and complex world has high demands on the social adaptation of the individual. Harmonious development is an important component of life success as well. The harmony of internal aspirations and external social demands is not present, but it is a necessary condition for self-realization in the social environment.

In the system of factors of harmonious development there is the activity of the person and this real circumstance requires adequate theoretical recognition.

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**Аннотация.** В статье представлены результаты теоретического и экспериментального исследования уровня сформированности гармонии и сбалансированности жизни у будущих специалистов. Как показало проведенное исследование, уровень гармонии, активности и внутренней энергии у студентов средний и низкий. Формирование гармоничной личности необходимо в рамках образовательного процесса, поскольку гармония внутренних устремлений и внешних социальных требований является необходимым условием для самореализации личности в социальной среде.

**Ключевые слова:** гармония, внутренняя энергия, самореализация, ценностные ориентации, гуманистическая среда вуза, социальная адаптация.

**Аннотация.** The article presents the results of a theoretical and experimental study of the level of harmony and balance of life in future professionals. As shown by the study conducted in Sevastopol state university at the department of “Physics”, the level of harmony, activity and internal energy of students is medium and low. The formation of a harmonious personality was proved to be necessary in the educational process, since the harmony of internal aspirations and external social requirements is a necessary condition for the self-realization of the individual in the social environment.

**Keywords:** harmony, inner power, self-realization, value orientations, humanistic environment of higher education institution, social adaptation.

**FACTORS OF MOTIVATION INCREASE TO STUDY  
MATHEMATICS BY STUDENTS OF NON-MATHEMATICAL  
SPECIALITIES**

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At present the motivation of students of non-mathematical specialties to study mathematics is one of the important elements of the educational process. "In particular it is connected with the existing underestimation of the importance of mathematics learning by students" [1, p. 10]. As a rule, students realize the importance of studying mathematics by the end of their studies at the university.

A research of this problem is of importance in pedagogics and psychology, as motivation encourages and stimulates cognitive activity. Methodological techniques and technologies aimed at the motivation formation to study mathematics are different.

This article analyzes the main factors that increase motivation to study mathematical disciplines by students of non-mathematical specialties.

"One of these factors is the use of computer and information technology during lectures and practical classes" [2, p. 287]. This makes it possible to give visibility to many mathematical concepts and helps students to take a new look at mathematical processes and phenomena and the use of specialized packages gives possibility to use the acquired mathematical knowledge in practice.

The next factor to increase the level of motivation to study the subject can be attributed to the creation of problematic educational situations, the organization of individual work of students and work in small groups. It should be noted that independent work of students is one of the effective incentives for the study of mathematics.

No less important role in motivating the study of mathematics is the organization of independent research and implementation of educational projects. Such practice is widespread both in higher education institutions with training of non-mathematical specialties and mathematical. The purpose of the students' research work and educational projects is to find methods for solving various problems, using mathematical calculations, including beyond the scope of the study course.

One of the methods to increase the motivation of independent study of mathematics by students is to conduct teacher problem lectures. "The task of the teacher during such lectures is to provide joint participation of

students in discussion of the given topic” [3, p. 15]. Each task set at the problem lecture is presented to students as a new knowledge. The study of this new knowledge is introduced as a new discovery in science, which is already implemented in the world, but not known to students. Thus, the interest of the student is due to the formulation of a new and unresolved problem.

A necessary condition for increasing motivation is the establishment of intersubject links between the stated mathematical material and disciplines articulated in a certain higher educational institution. “The teacher should show the relationship of mathematics with other disciplines” [4, p. 36]. Moreover, not only students' attention focusing on these relationships, but also directly supporting the solution of relevant applied tasks is a powerful stimulating factor for active activity and contributes to the formation of students' understanding of the importance of studying mathematics for the future profession.

The study of theorems and proofs to theorems presents a difficult task for students of non-mathematical specialties, but the identification and demonstration of internal connections between some proofs of theorems having the same structure of proofs makes it possible to facilitate this task, as well as to organize the direct connection of concepts within the studied subject. In particular, such connections can be established in the presentation of certain double and triple integrals.

The next factor in increasing motivation of mathematics studying is subject teaching in easier and more accessible form for students to understand. For this purpose mathematical problems are presented by means of illustration show, selection of various tasks and examples. A differentiated approach to the teaching of mathematical discipline is proposed, in which students can choose the level of difficulty of material mastering, for example, the basic intermediate and advanced level.

E.V. Shulga proposed one of the motivational approaches from the model, which is based on a phased study of the mathematical discipline. “The structure of one is as follows:

- 1) Mathematization of the empirical material;
- 2) Logical organization of mathematical material;
- 3) Application of mathematical theory” [5, p. 132].

The application of this model is made gradually from the first to the second stage, from the second to the third. The advantage of this approach is that this scheme of material studying can be adapted to each student with a different level of mathematical knowledge.

Pedagogical activity of the teacher, the style of presentation of the material, his/her professional competence and love of the subject, the ability



to find an approach to each student, to support and indicate the strengths of students should be noted and referred to the factors that contribute to increase interest in the subject in particular.

The use of the above mentioned factors of stimulation to strengthen the motivation for the study of mathematics must be carried out in complex, which gives the possibility to obtain a positive effect of mathematics studying, to increase the student's interest in the subject acquisition and to master professional competence as well.

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**Аннотация.** В статье автором рассмотрены и проанализированы стержневые факторы повышения мотивации к изучению математических дисциплин студентами нематематических специальностей, таких как использование компьютерных технологий, создание проблемных ситуаций, проведение проблемных лекций, привлечение к научно-исследовательской работе посредством выполнения учебных проектов, установление межпредметных и внутрипредметных связей, изложение материала в доступной форме, стиль педагогической деятельности преподавателя. Основным выводом является необходимость осуществления комплексного

подхода к обучению студентов, в рамках которого могут применяться все перечисленные методы. Это позволит реализовать главную задачу – актуализировать самостоятельное изучение студентами математики.

**Ключевые слова:** мотивация, математика, нематематические специальности, повышение мотивации.

**Annotation.** The author considers and analyzes the main factors of motivation increase to the study of mathematical disciplines by students of non-mathematical specialties, such as the use of computer technology, creating problem situations, conducting problem lectures, involvement in research work through the implementation of educational projects, the establishment of intersubject and intra-subject relations, presentation of material in an accessible form, the style of pedagogical activity of the teacher. The main conclusion of the article is the need for a comprehensive approach to teaching students, in which all of these methods can be used. It will allow to realize the main task – to actualize independent mathematics studying by students.

**Keywords:** motivation, mathematics, non-mathematical specialties, motivation increase.

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## **EL PAPEL DE LA MUSICA EN EL PROCESO DE LA ADQUISICION DEL LENGUAJE**

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Una canción auténtica en un idioma extranjero está examinada en el artículo como un elemento especialmente importante en un discurso extranjero que tiene un cierto potencial lingüístico y didáctico. En la enseñanza de las lenguas extranjeras, una canción se considera tradicionalmente como un medio eficaz para mantener el interés y motivar a los alumnos. Eficiencia de canciones es tan alta que las canciones especialmente seleccionadas pueden ser integradas no solo en un tipo de

clases especiales, sino también pueden convertirse en la base de cursos o materiales de aprendizaje.

A pesar de todos los beneficios de la metodología basada en la escucha y trabajo con canciones, el uso de ellos en la metodología de enseñanza de Rusia es limitado. Por regla general, las canciones se incluyen solamente en las clases individuales o en parte (una lección) de libros de texto, como "elemento de alegría y descansa". Por consiguiente el objetivo de este trabajo es demostrar que la canción puede considerarse como una muestra especialmente organizada del discurso, que tiene un valor lingüístico-didáctico distinto, que le permite ser un método completo para el aprendizaje.

Para Vigotsky, el lingüista ruso famoso, la motivación es lo que induce a una persona a llevar a la práctica una acción, es decir, estimula la voluntad de aprender. Aquí el papel del docente es inducir motivos en los aprendizajes de los alumnos y desarrollar comportamiento para aplicarlos de manera voluntaria a los trabajos de clase. La motivación escolar no es una técnica o método de enseñanza particular, sino un factor cognitivo presente en todo acto de aprendizaje, que condiciona la forma de pensar del alumno y con ello el tipo de aprendizaje resultante [2].

Escuchar, aprender y cantar canciones en clase es una práctica de valor didáctico incalculable. Son textos orales ideales para practicar aspectos tales como el ritmo, la velocidad y la pronunciación correcta, además, como actividad lúdica, las canciones suponen una alternativa a otros ejercicios de repetición poco motivadores. La música tiene un componente afectivo, ya que su poder evocador puede cambiar nuestro estado de ánimo según el tipo de melodía que estamos escuchando o según la letra de cada canción. Es un detonante y un modo de expresar nuestros propios sentimientos. También se ha sabido que el conocimiento musical se procesa globalmente en varias partes del cerebro, pero no sólo en las áreas de procesamiento del sonido y del lenguaje, sino incluso en centros ajenos, como los destinados a la visión. De ahí que la música tenga un poder evocador que estimula la imaginación visual, el entorno lingüístico, la memoria [4].

Para conseguir un aprendizaje más duradero, la implicación de las emociones es fundamental, y las canciones son una forma de manifestar sentimientos difíciles de expresar. La música tiene un gran poder para la estimulación de las emociones, la sensibilidad y la imaginación sin olvidar las consecuencias que se derivan de la capacidad que poseen las canciones para engancharse y permanecer en nuestra memoria. Gracias a las canciones se pueden practicar ejercicios de repetición sin que los alumnos los perciban como tales, sino como una práctica necesaria en la canción, por tanto en un contexto comunicativo y natural. Las canciones desarrollan todas las

destrezas lingüísticas y ponen en funcionamiento los dos hemisferios cerebrales. Las canciones se pueden usar para: – enseñar vocabulario; – fomentar la creatividad; – practicar pronunciación; – desarrollar la comprensión oral y lectora; – remediar errores frecuentes; – desarrollar la expresión oral y la escrita; – estimular el debate en clase; – repasar aspectos morfosintácticos; – enseñar cultura y civilización; – desarrollar el sentido rítmico y musical; – estudiar las variedades lingüísticas del idioma que se enseña; – motivar a los alumnos para aprender el idioma extranjero [1].

En la mayoría de los casos, por ejemplo, aprender la gramática es complicado y aburrido para los estudiantes, como resultado muchos de ellos pierden interés en el tema. Por estas razones se vuelve necesario buscar nuevos enfoques para el proceso de aprendizaje. La canción puede ser una excelente alternativa. Abajo hay ejemplos cómo presentar varios aspectos gramaticales a los estudiantes usando las canciones.

1. El uso de las preposiciones **por y para** en la mayoría de casos es difícil para algunos estudiantes, por eso es positivo ver ejemplos de cuando se usa. Uno de estos ejemplos es la canción “Por la raja de tu falda” del dúo catalán Estopa. La canción

2. es muy divertida y va a gustar a los estudiantes. Además se utiliza un lenguaje colloquial:

*“Llegamos tarde **para** variar  
Y el tío del garito está mosqueao  
Porque aun no hay nada montao...  
De repente se abrió la puerta,  
Mientras yo cogía la guitarra,  
Al ver de Nuevo la raja de tu falda.  
**Por** la raja de tu falda yo  
**Rompí** tres cuerdas de esta guitarra...  
**Por** la raja de tu falda  
Yo me he obsesionado y yo voy de barra en barra  
**Por** la raja de tu falda  
Yo tuve un piñazo con un Seat Panda  
**Por** la raja de tu falda  
Yo tuve un siniestro con un Seat Panda...” [3].*

Otro fenómeno gramatical que debemos analizar es **Imperativo**. Es el caso de la canción “París” con la que podemos observar este aspecto en español. Las letras de un grupo musical “Oreja de Van Gogh” suelen ser simples para los estudiantes y tienen mucha variedad que permiten practicar muchas formas gramaticales.

*“**Ven** acércate  
**Ven** abrázame*

*Vuelve a sonreír, a recordar París,  
A ser mi angustia  
Déjame pasar una tarde mas  
Dime donde has ido...  
Ven, te quiero hablar  
Vuelve a caminar..." [5].*

La alternancia entre **Preterito Indefinido** y el **Preterito Imperfecto** también suele ser problemático. Esta canción puede ayudar a ver que usamos el pretérito imperfecto para describir situaciones y el indefinido para expresar acciones. El autor de esta canción "Y nos dieron las diez" Joaquín Sabina, mezcla en sus canciones el lenguaje poético con otro más colloquial:

*"Y no halle quien de ti  
me dijera ni media palabra,  
parecía como si  
me quisiera gastar el destino una broma macabra.  
No había nadie detrás  
de la barra del otro verano.  
Y en lugar de tu bar  
me encontré una sucursal del Banco Hispano Americano,  
tu memoria vengué  
a pedradas contra los cristales.  
"Sé que no lo soñé"  
Protestaba mientras me esposaban los municipales  
en mi declaración  
Alegué que llevaba tres copas  
Y empecé esta canción  
en el cuarto donde aquella vez te quitaba la ropa  
Y nos dieron las diez y las once, las doce y la una  
y las dos y las tres  
y desnudos al anochecer nos encontró la luna..." [3].*

Aquí hemos dejado solo una pequeña lista de canciones, pero hay muchísimas más que contienen otros ejemplos gramaticales y de vocabulario. Considerado todo lo dicho anterior podemos concluir que la auténtica canción es material de enseñanza significativa y metódicamente efectiva, cuya integración en la sesión de clase asegura la asimilación de los fenómenos lingüísticos e información etnocultural, aumenta la motivación, atrae el interés al idioma.

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**Аннотация.** В данной статье «песня» рассматривается как эффективный самостоятельный методологический прием, обладающий определенным лингводидактическим потенциалом. Анализируются механизмы влияния музыки на образовательный процесс. Приводятся примеры различных аутентичных испанских песен как методологического материала для закрепления определенных грамматических категорий, пополнения словарного запаса, погружения в культуру страны изучаемого языка, поднятия уровня мотивации, а также создания комфортной образовательной среды.

**Ключевые слова:** иностранный язык, образование, аутентичная песня, дискурс, методология.

**Summary:** Authentic song is considered as an effective and valuable methodological tool possessing a certain linguodidactic potential. The influence mechanisms of music on the educational process are analyzed. Different examples of the authentic Spanish songs are presented as a methodological material for consolidating certain grammatical categories, vocabulary replenishment, immersion in the culture of the country of the studied language, raising the level of motivation, as well as creating comfortable conditions in the course of the educational process.

**Key words:** foreign language, education, authentic song, discourse, methodology.

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## **LOS MÉTODOS INTERACTIVOS EN LA ENSEÑANZA DEL ESPAÑOL EN LA UNIVERSIDAD MODERNA**

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En la Universidad Estatal de Sevastopol se estudia el inglés, español, francés, alemán y japonés.

Para motivar a los alumnos en el aprendizaje de esas lenguas extranjeras se presta especial atención a la utilización de métodos de enseñanza interactivos (MEI) en el proceso educativo. Definamos el concepto MEI. El término "interactivo" se deriva del Inglés "interactuar" ("entre" mutuo, "acto" de actuar). MEI (formación en línea) es una forma especial de organización de las actividades cognitivas, que implica un objetivo muy específico y planificado. El MEI se basa en los principios de cooperación, en la experiencia en grupo, y una retroalimentación obligatoria. Se crea un ambiente de comunicación educativa, que se caracteriza por la apertura, la interacción de los participantes, la igualdad de sus argumentos, el conocimiento común, la posibilidad de evaluación y el control mutuo.

Con respecto a los signos de los métodos de enseñanza interactivos, su característica estructural de interacción está disponible con el estudiante en su propia experiencia de la vida, la profundización y el trabajo integral con esta experiencia. La experiencia del estudiante en la enseñanza interactiva es la principal fuente de conocimiento académico [1, p.282].

El profesor no funciona como traductor de la información pero organiza la actividad cognitiva independiente del estudiante para la producción de los conocimientos sobre la realidad, hace la búsqueda, el estudio de los fenómenos y procesos, la resolución de problemas independientes. El profesor es una de las fuentes de información. Su función es crear condiciones para que los estudiantes muestren actividades sobre esta iniciativa, en particular, informativa. El papel principal del profesor es la de facilitador, la de asistente en la organización de la actividad mental de los estudiantes.

En nuestra opinión, la característica definitoria de la actividad de aprendizaje interactivo es una manifestación de los estudiantes y la combinación, la relación de la física (movimiento por el aula, el cambio del lugar de trabajo, la pintura, la fijación, etc.), sociales (intercambio de opiniones, ideas, defender su punto de vista, etc.) y las actividades cognitivas (la conciencia de sí mismos como una fuente de experiencia, la búsqueda de soluciones a los problemas, etc.) a la vez.

El análisis de la aplicación práctica de los métodos interactivos de enseñanza nos permitió poner de relieve sus características y otros instrumentos: una orientación antropológica, el diálogo, el pensamiento, las relaciones intersubjetivas, la libertad de elección, la situación de éxito, variación positiva y optimista, la reflexión, etc [5].

En lo que toca a la clasificación de métodos interactivos, es posible

numerarlos según su función de liderazgo en la interacción pedagógica de los siguientes grupos:

- Métodos para crear un entorno favorable, la organización de la comunicación.

- Métodos de organización del intercambio de la actividad.

- Métodos de organización de pensamiento.

- Métodos de organización de sentido.

- Métodos de organización de la actividad reflexiva.

- Métodos de integración (juegos interactivos).

En nuestra opinión, el uso de métodos interactivos en el aula de la lengua española está dirigido principalmente al desarrollo de la competencia comunicativa de los estudiantes.

Para ello, las clases están organizadas en juegos individuales, en parejas y en grupo, en proyectos de investigación aplicada, juego de roles, y también estamos trabajando con los artículos, vídeos, películas, canciones y otras diversas fuentes de información utilizadas para el trabajo creativo (Quizlet, TedTalks, El Mundo), así como los métodos online. Hay que tener en cuenta que la formación en línea permite resolver varios problemas a la vez. Lo más importante es que desarrolla las habilidades de comunicación de los estudiantes, ayuda a establecer contacto emocional entre los estudiantes, soluciona un problema educativo, como el trabajo en equipo o escuchar las opiniones de sus compañeros. Estos métodos interactivos de enseñanza utilizados en el aula de lengua extranjera contribuyen a mejorar el aprendizaje y la actividad cognitiva de los estudiantes, aumentan la motivación para aprender la lengua extranjera, y, en consecuencia, la mejora de la calidad del aprendizaje.

Cuando se utiliza un método interactivo de enseñanza, el estudiante se convierte en un participante con pleno derecho en el proceso de percepción, y su experiencia es la principal fuente de conocimiento educativo. El profesor no proporciona los conocimientos ya hechos, sino que estimula a los estudiantes en la búsqueda libre [3].

El profesor se convierte en una especie de filtro por el que pasa la información, y sirve como ayudante en el trabajo, como una fuente de información. El aprendizaje interactivo es ampliamente utilizado en el entrenamiento intensivo. Para aprender y utilizar estos métodos, el profesor debe conocer los diferentes métodos de interacción grupal. La formación en línea ofrece entendimiento, cooperación y enriquecimiento mutuo.

Estamos de acuerdo con la mayoría de los especialistas en que el aprendizaje interactivo da al maestro una excelente oportunidad para una mejora en la calidad de organizar la interacción pedagógica, para que sea atractivo para los estudiantes y fortalecer su motivación positiva para



aprender, y para crear las condiciones de su desarrollo.

En nuestra opinión, la esencia del aprendizaje interactivo se refleja en el siguiente proverbio chino: "Dime – y yo olvido; Muéstrame – y yo recuerdo; Dame una oportunidad - y yo puedo". En este sentido, mostramos el uso de métodos de enseñanza interactivos empleando los juegos como:

### **1) Alias**

Es un juego de palabras con gran éxito para saber explicar las palabras de cualquier tema imaginando situaciones y adivinando. Puede ser usado durante el aprendizaje del material o vocabulario de los libros del texto.

En este juego de palabras hay que describir el término clave con sus sinónimos, palabras similares, asociaciones, pero no se puede utilizar este término dado o el raíz del término.

Un estudiante recibe una tarjeta con cinco palabras y tiene un minuto para explicársela a los demás. La audiencia adivina las palabras mejorando sus habilidades de escuchar uno a otro y de exponer brevemente sus suposiciones. Por ejemplo, la lista de palabras del tema "Espacio Cósmico":

*Selenico* (lunar)

*Sistema solar* (es un conjunto de las planetas, satélites, asteroides y cometas)

*Antimisil* (defensa tierra-aire contra misiles)

*Camarote* (un lugar donde descansa la tripulación)

*Transbordador* (astronave para transportar al espacio objetos o aparatos, como misiles, satélites, etc.)

Alias es una oportunidad para demostrar y practicar el ingenio de estudiante, su retórica rápida, hábil y fuerte en el lenguaje.

### **2) ¿Quién soy yo?**

Este juego sirve para amenizar las clases en el nivel básico del aprendizaje de las lenguas, para mejorar el vocabulario de los temas como la apariencia, la personalidad, las partes del cuerpo o rasgos físicos, la ropa etc. Los estudiantes del primer curso comienzan a perder el miedo a hablar español y a expresarse delante de otros estudiantes, lo cual es muy importante en la competencia de comunicación.

Las reglas del juego son muy sencillas:

1. Varios participantes deben situarse en círculo.
2. Cada uno de los participantes debe escribir en un papel el nombre de un personaje (real o de ficción).
3. Cuando todos tengan escrito el personaje deben pegarlo en la frente del compañero que tengan situado a su derecha.
4. Entre todos deben elegir a uno para que empiece a formular preguntas para intentar descubrir el personaje que tiene en la frente.

5. Las respuestas tienen que ser del tipo "Sí-No", por ejemplo: ¿soy un personaje de dibujos animados? Si la respuesta es 'Sí' el jugador formula otra pregunta y así hasta que falle, cediendo el turno al estudiante de su derecha.

6. Según vayan adivinando el personaje, irán saliendo del juego.

El juego "¿Quién soy yo?" es bastante fácil de organizar y definir en el aula y es uno de los favoritos entre los estudiantes por su simplicidad y diversión.

### **3) Story cubes**

Jugando en *Story cubes* los estudiantes dejan volar su imaginación enlazando las imágenes que salgan en los dados para crear una historia.

Es muy útil para practicar los tiempos gramaticales, el modo subjuntivo, construcciones en infinitivo, gerundio y especialmente para trabajar la concordancia de los tiempos.

Instrucciones:

El primer estudiante lanza los nueve dados y escoge una de las imágenes para empezar a contar su historia "Erase una vez..." empleando los temas gramaticales aprendidos o dados por el profesor. La segunda oración se dedica al otro estudiante que debe continuar la misma historia pero teniendo en cuenta la imagen en su dado. Es evidente que no hay respuestas incorrectas y con la práctica sus historias serán cada vez más coherentes, largas y correctas en el plano gramatical y estructural.

También el profesor puede indicar un tema especial, por ejemplo "El viaje en un avión" y los demás tienen que usar el vocabulario esencial empleando las palabras temáticas en su cuento.

Además, las instrucciones incluyen varias maneras diferentes de utilizar los cubos para mejorar la imaginación de los estudiantes y aumentar sus capacidades de encontrar temas unificadores entre diversas imágenes.

### **4) Batalla naval**

La batalla naval del nombre en inglés "battleship", es un juego tradicional de adivinación que involucra a dos participantes. Este juego ayuda practicar el vocabulario y los tiempos gramaticales trabajando en parejas.

Cada estudiante maneja dos tableros divididos en casillas. Cada tablero representa una zona diferente del mar abierto: la propia y la contraria. En uno de los tableros, el jugador coloca sus barcos y registra los "tiros" del oponente; en el otro, se registran los tiros propios, al tiempo que se deduce la posición de los barcos del contrincante.

Al comenzar, cada jugador posiciona sus barcos en el primer tablero, de forma secreta, invisible al oponente. Es decir, el estudiante forma la oración de las palabras de ambas líneas (horizontales y verticales). Por

ejemplo, el tema dado por el profesor es "Las preposiciones de lugar". En línea horizontal se escribe el mobiliario (la mesa, las sillas, el armario, etc.) y en línea vertical las preposiciones (entre, detrás de, encima de). Así, el estudiante "dispara" diciendo a su oponente "la mesa está detrás de la puerta" indicando una supuesta posición.

Si esa posición es ocupada por parte de un barco contrario, el oponente cantará "¡Tocado!" si todavía quedan partes del barco (casillas) sin dañar, o "¡Hundido!" si con ese disparo la nave ha quedado totalmente destruida (esto es, si la acertada es la última de las casillas que conforman la nave que quedaba por acertar). Si la posición indicada no corresponde a una parte de barco alguno, cantará "¡Agua!".

Quien destruya primero todas las naves de su oponente será el vencedor.

Pueden implementarse muchas variantes, dentro de las que se encuentran el tamaño de la cuadrícula de los tableros, el tamaño de los barcos, la cantidad de naves, la cantidad de tiros permitidos, la forma de disparar, etc.

Con ayuda de este juego se pueden desarrollar las habilidades de formar las oraciones en una forma correcta y enriquecer el vocabulario más rápido, con mucha atención e interés verdadero al tema correspondiente.

A medida que se adquiere experiencia, el uso de los juegos anteriores ayuda a los estudiantes de manera eficiente y rápida a dominar la gramática, el léxico, enriquecer el vocabulario, aliviar la tensión, y es posible cambiar los modelos de actividad modificando las cuestiones clave que se quieren tratar. Al final, se puede mejorar en gran medida la calidad del material y la eficiencia de su asimilación, y, en consecuencia, la motivación para el aprendizaje de español de los estudiantes.

En definitiva, hay que señalar que el uso en el proceso educativo de los métodos y técnicas interactivos de enseñanza de lenguas extranjeras desarrolla las habilidades comunicativas de los estudiantes, ayuda a establecer contacto emocional entre los estudiantes y les enseña a trabajar en equipo, escuchar las opiniones de sus compañeros, y establecer así un contacto más estrecho entre los estudiantes y el profesor.

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**Аннотация.** Главной стратегией обучения в современном вузе должна стать ориентация на самостоятельную активность обучаемого; на практическое обучение, где у будущего специалиста есть выбор действий и возможность проявить инициативу; на гибкие обучающие программы, позволяющие преподавателю и студенту работать в удобном ритме. В связи с этим, представляем краткий обзор игр, которые практикуются на занятиях по испанскому языку в современном университете и вызывают у студентов живой интерес к обучению. Игры, меняя роль преподавателя с транслятора информации на организатора и координатора образовательного процесса, позволяют комплексно формировать коммуникативную и профессиональную компетенцию.

Также, в статье речь идет об использовании интерактивных методов профессиональной подготовки, осуществление которых пробуждает интерес к профессии, способствует эффективному усвоению учебного материала и его прочность, формирует стереотипы профессионального поведения, обеспечивает высокую мотивацию, командный дух и свободу самовыражения.

Кроме того, использование интерактивных ресурсов и средств в обучении демонстрирует гибкость системы образования в современном университете, ее адаптивный характер, т.е. своевременное приспособление к новым технологиям.

**Ключевые слова:** интерактивные методы обучения, коммуникативная компетенция, профессиональная подготовка, мотивация, когнитивная деятельность.

**Summary:** The main strategy of education in a modern university should focus at an independent activity of a student; at his practical learning, where a future professional has a choice of activities and a possibility to take the initiative; at flexible learning program that helps both

student and teacher to work in a convenient way. In this regard, we represent a revue of games that are being practiced during Spanish lessons at a modern university and arouse students' keen interest on apprenticeship. Changing the role of a teacher to the information translator of an educational process, games let comprehensively form communicative and professional competence.

Furthermore, the article tells about the usage of training interactive methods, implementation of which awakes interest to the profession, contributes to efficient learning and its durability, develops the stereotypes of professional behavior, and provides motivation, team spirit and the freedom of expression.

In addition, the use of interactive resources and teaching tools shows flexibility of educational system in a modern university, its adaptive type, so called prompt adaptation to new information technology.

**Key words:** interactive teaching methods (ITM), communicative competence, apprenticeship, motivation, cognitive activities.

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## **ANALYSIS OF PROBLEMS AND PROSPECTS FOR CHILDREN'S RECREATION IN SEVASTOPOL**

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It's common knowledge that children's tourism is one of the mass kinds of tourism performs educational, health-improving, recreational and other socially significant functions as well. In Russian Federation our children's tourism has the status of socially, controlled by various regulations and legal acts, both at the federal and regional levels.

### **Importance of children's tourism:**

Children's sports - health tourism are one of the most effective health technology for healthy lifestyle, and it have a big state matter for educational of new generations, also this is a way of personality socialization.

### **Development of children's tourism in Sevastopol:**

General tourism for Sevastopol today is 3-5% of the total budget of the city. Taking into account the potential of the tourist industry of Sevastopol - incomes from tourism are insignificant and the tourist potential of the city is not realized.

For today, Sevastopol has to compete with the resorts of other cities of the Crimea (in particular Yalta, Alushta and the South Coast as a whole).

Tourist branch of Sevastopol, engaged in children's tourism, offers in-house children's tourism (health camps, reception and excursion services for organized children's groups) and to a lesser extent international tours (language study, sports recreation, field trips). Children's sightseeing tours have a pronounced seasonality, tied to school holidays and holidays.

On the territory of Sevastopol, 8 children's health camps (Joy, Nakhimovets, Laspi, Alkadar, Chaika, Gorny, Alsu, Omega). More than 50% of holidaymakers in children's camps are Sevastopol children. In 2017, 4113 Sevastopol children of certain categories were free of charge in the camps of Alkadar, Chaika, Radost and Gorny. These are orphans, children from large and poor families, children who are on dispensary registration, talented and gifted, and also children whose parents died in the line of duty. At the beginning of 2018, two children's camps "Omega" and "Alsu" were transferred to the city's balance, and the children's camp "Laspi" was put into operation after the reconstruction. To date, of the above, only one children's camp in Sevastopol can technically function in Sevastopol year-round - this is the children's camp "Laspi". Sevastopol is called "the city of glory of the Russian fleet", since many important historical events are associated with the victories of Russian admirals and sailors in the Crimea.

It is very important that new generation honors the history. Development of historical, cultural and patriotic children's tourism in Sevastopol is our future.

Particular attention deserves development of sport children's tourism in Sevastopol. Tours are in great demand, where, in addition to rest, children continue to do some sport (swimming, cycling, football) during school holidays. The programs for children's recreation of the type "mountains + sea" are popular, during which children spend some time in a camp located in the mountainous area, doing active recreation there (equestrian, paintball, archery), and then move to the summer seaside camp where time is already spent by the sea.

#### **Problems of children's tourism in Sevastopol:**

1. A small selection of budget accommodation for organized children's groups of more than 30 people in rooms of the same type with private facilities.

2. Lack of developed sports infrastructure.

Lack of opportunity to provide children with sports facilities for sports events and training - modern swimming pools, football fields, equipped gyms.

3. Lack of the necessary amount of specialized transport for the

transportation of children.

Transportation of children under the legislation of the Russian Federation should be carried out by specialized transport, accompanied by specialized cars of the State Automobile Inspection. Unfortunately Sevastopol in this issue is represented by a very small number of specialized buses.[4]

#### 4. Children's camps functioning problem.

Climatic features of cultural and historical attractions of the Crimea allow to carry out year-round improvement of children in the Crimea and the city of Sevastopol. However, for today only one children's camp in Sevastopol technically can function in Sevastopol all the year round - this is the children's camp "Laspi"[1]. Sevastopol and Crimea are rich in a variety of places that can be visited and not only in the summer. However, this direction is not developed.

#### 5. Underdevelopment of infrastructure, high depreciation of fixed assets of children's camps.

The main problem of children's camps in Sevastopol is the inconsistency with their modern requirements in the conditions of living (5-7 local chambers, with amenities on the floor or on the street, with hot water on schedule), while the requirements of customers have long shifted towards 2 -3-bed accommodation with private facilities in the room. Absence of major repairs in buildings and structures, discrepancy of accommodation with fire safety standards [1].

#### 6. Lack of professional staff.

Seasonality of work does not attract people to work on sites. A low level of salaries is not interested in local cadres, and the attraction of foreign citizens is associated with a lot of bureaucratic delays.

#### **Existing ways to solve problems.**

In most regions of the Russian Federation, children's rest is regulated not only by the executive authorities, but also by the acts developed and adopted. Some regions have programs directly dedicated to the organization of recreation and health improvement for children and teenagers: "Children", "Children and family".

In 2014, a government decree was organized by the Coordinating Council for the Development of Children's Tourism in Russia. The purpose of the Council is to improve the regulatory and legal regulation of the development of children's tourism. Decision of 05.06.2015. №486-PP Regional Council for the development of children's movement in the city of Sevastopol. One of the priorities of the new created council is the development of childhood, as well as patriotic education among young people, stimulating interest in understanding the natural and cultural

heritage of Russia [3].

With the assistance of the Coordination Council and for model development program recreation systems of children in the Russian Federation, we can improve the efficiency of recreation system of children in regions of the Russian Federation due to the creation of conditions for attraction of additional, including non-State resources in children's leisure sector with use of educational component and the variability of children's leisure programs and other measures which children and their parents needs for they rest.

The task of this program is reconstruction and development of infrastructure for country recreation and improving children's health, improving the quality of programs for children's developmental recreation, developing effective mechanisms for managing and financing the system, attracting children's programs, attracting diverse (financial, organizational, personnel, etc.) resources [2].

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**Аннотация.** В данной работе мы рассматриваем вопросы детского туризма в Севастополе. Обсуждаются актуальные проблемы и их возможные пути решения, перспективы развития рекреационных ресурсов Крыма. Большое внимание уделяется на значимость детского туризма в наше время; возможность составление новых программ его развития на примере модульных программ. Описывается важность и возможности развития спортивного, а также культурно-исторического направлений туризма, что необходимо для воспитания и развития детей.

**Ключевые слова:** отдых, детский туризм, оздоровление, детские лагеря, рекреация, инфраструктура, размещение.



**Summary:** In this work we consider the issues of children's tourism in Sevastopol. The actual problems and their possible solutions, the prospects for the development of the recreational resources of the Crimea are discussed. Much attention is paid to the importance of children's tourism in our time; the possibility of drawing up new programs for its development using the example of modular programs. The article describes the importance and opportunities for the development of sports, as well as cultural and historical directions of tourism, which is necessary for the upbringing and development of children.

**Key words:** recreation, children's tourism, health improvement, children's camps, recreation, infrastructure, accommodation.

UDC 316

## **EDUCATION IN THE CONTEXT OF THE MODERN INFORMATION CHALLENGES**

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The intensification of modern globalization processes, the onset of the information age and networkization have firmly integrated information technologies in the life of society and initiated the emergence of new agents of socialization. This resulted in an intensive modification of public institutions and processes, including processes that affect the formation of the individual. The modern "human, in fact, ... is forming and functioning in the mega-information space ..." [1]. Immersion in the information space of such a traditional social institution as education has led to fundamental transformation processes: the education system, the educational environment and the technologies used are being changed.

The formalization of the information society can be viewed as a kind of global challenge for the education system, since the emergence of a new era does not simply change the values of society, forcing them to rethink the old ones, but also correlates with the paradigm shift of education.

Of course, it should be emphasized that most of the achievements of the twentieth century (medicine, space, etc.) and modernity in many respects have become possible due to the established traditional education

system. However, the further development of modern civilization is connected with the answer to such a key question as what exactly the modern personality is, what its professional level should be and how, in accordance with this, the education system should be built.

Information and communication technologies (ICT) radically change our habitual way of life and, if properly used, are potentially capable of improving the living conditions and quality of people's life. In this context, the idea of creating a "smart city" (as a kind of reaction to the growth of the urban population), in which the "smart personality" is intended to become the basis for the development of modern urban space, is getting actualized. Of course, the formalization of the digital economy, professional management, the development of urban infrastructure, innovative transformation of the social sphere are difficult without a creative and responsible personality, a specialist in their field. It is possible to agree with D. Bell that "the main actor is a professional, because his education and experience allow him to meet all the requirements" of modernity [2, p. 172].

The traditional model of the organization of the educational process, aimed primarily at obtaining reproductive knowledge, today does not correspond much to the level of a modern specialist's qualification. The rapid updating of knowledge and the development of Internet technologies come sometimes in a peculiar contradiction with the organization of education on a classical pattern. Due to the accessibility of almost any information, educational institutions gradually lose the function of a monopolist in providing access to knowledge, which undermines to some extent their prestige and authority [3, p. 80].

The openness of the information space promotes the spread of the philosophy of the so-called "smart education", which is more flexible in a constantly transforming environment. Today students are actively learning the disciplines, using the materials of electronic sites. Libraries integration, provision of access to electronic educational resources and creation of a system of additional remote digital education take place outside of spatial and temporal boundaries. Today, there is the opportunity to select educational disciplines in accordance with cognitive interests, which creates a basis for the disclosure of personal potential and is a prerequisite for career growth.

There is a popularization of distance and e-learning, marked by mass character. This makes it possible to practically eliminate the segregation of students by age, intellectual criterion, social status and other parameters.

"Smart education" not only provides a traditional link between students and teachers, but also allows to individualize education programs. The "subject-subject" approach is embedded, the teacher becomes a

colleague, that is, the dialog (the dialogic nature of education) is developed. In this format of work, not only is there the spirit of cooperation, involvement in the common cause (without regard for profile education), but also development of the skills of analytical comprehension of the information, the capacity for scientific and creative search and many others. As a result, it allows to get a specialist with the ability to constantly self-educate, which makes "intelligent education" the fundamental basis of the "smart city".

It should be noted that the city government of Sevastopol in early 2018 approved the concept of "smart city", according to which the formation of the digital environment of the city through the development and use of ICT in various fields of activity is envisaged. In the field of education, this project involves improving the level of safety during the educational process, the comfort of receiving services and informing the public about the entire educational process. Integration and interaction with the projects "Modern digital educational environment of the Russian Federation" and "Digital school" [4] are supposed.

Thus, the existence of a global information space correlates today with the possibility of obtaining knowledge anywhere and at any time. However, the introduction of information technologies into the sphere of education is not just its digitization, it is a certain way of organizing the process of knowledge transfer. As the rector of the Lomonosov Moscow State University academician V.A. Sadovnichiy notes, for the formation and development of a society based on knowledge, you need a person who owns the fundamental knowledge [5]. Therefore, the key priority today is the formation of an "intelligent personality" - a professional who is capable of constant self-education and self-development, who has actual knowledge and competencies, ready to adapt to the permanently transforming environment and, if necessary, to the new career development.

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**Аннотация.** В статье анализируются вопросы, связанные с наиболее значимыми аспектами информационно-коммуникационной революции. Подчеркивается, что нарастающая изменчивость мира и трансформация самого человека коррелирует с необходимостью соответствия образования вызовам современности.

Автор, рассматривая специфику института образования на современном этапе, заостряет внимание на философии так называемого «умного образования». Акцентируется, что приоритетным сегодня является формирование творческой и ответственной личности, профессионала в своей области.

**Ключевые слова:** личность, информационно-коммуникационные технологии, «умное образование», профессионал, Россия, Севастополь.

**Summary.** The article represents analysis of issues related to the most significant aspects of the information and communication revolution. It is emphasized that the increasing variability of the world and the transformation of the individual correlate with the need for conformity of education to the challenges of modernity.

Considering the specifics of the institution of education at the present stage, the author focuses attention on the philosophy of the so-called "smart education". It is highlighted that the formation of a creative and responsible person, a professional in his field comes as a today's priority.

**Key words:** individual, information and communication technologies, "smart education", professional, Russia, Sevastopol.

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## THE FEATURES OF SELF-ASSESSMENT IN YOUNGSTERS

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The problem of studying self-esteem in youth is relevant because this age period is unique - it is at the junction of the epochs of childhood and adulthood, which is the most important characteristic of youth. In this period of life, the behavior of young men and women changes significantly, the main life goals and the meaning of life are determined.

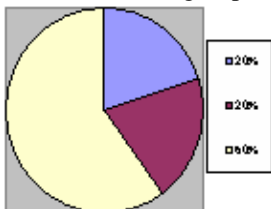
Self-esteem is of great importance at this age stage - it is its level that influences the development of a person in society, its adaptation to new social conditions, to society as a whole.

Borozdina L. V. wrote that Self-esteem is the presence of a critical position of the individual in relation to what they have; this is an assessment in terms of a certain system of values [1]. American psychologist W. James proposed a formula for self-esteem:  $\text{Self-esteem} = \text{Success} / \text{Level of aspiration}$  [2]. Based on the formula, it should be noted that self-esteem can be increased either by reducing the level of claims, or by increasing the success of their actions.

Adequate level of self-esteem is especially important in adolescence, as it plays a big role in adaptation in society. In this age, the formation of adequate self-esteem is one of the most important tasks, since both extremes - both underreported and overestimated self-esteem - lead to serious internal and interpersonal conflicts. The existence of these conflicts is explained by the fact that self-respect, self-acceptance and social adaptation are closely interrelated. In this way high self-esteem is evidence that a person respects himself, has a positive attitude towards himself, a low one - dissatisfaction with himself, a negative evaluation of his own personality [3].

To identify the level of self-esteem in the youth, the method of Budassi [4] to study the self-esteem of the personality was used, as well as the method of Eysenck [5] of self-assessment of mental states for establishing the relation of the level of self-esteem with the prevailing mental state. The study was conducted at the Sevastopol State University. Participated 10 subjects, of whom were 9 girls and 1 young man aged 18-20 years who are studying in the 2nd year of the institute.

Having carried out the study on the technique of Budassi, and processing the results, test subjects were divided by levels of self-assessment into 3 groups: high, medium and low levels of self-esteem. Also, a trend was revealed: most subjects had a high level of self-esteem (Figure 1).



Of 10 students:  
 - 6 have high self-esteem  
 - 2 have medium self-esteem  
 - 2 have low self-esteem

Figure 1. Levels of self-esteem among students

It can be concluded that in this group of 10 subjects only 20% have an understated level of self-esteem, which is a good indicator in general with respect to the rest of the group.

Based on the results of the method of self-assessment of mental states (by Eysenck), it was revealed that aggression is the prevailing condition in a group with high self-esteem (on the method of self-assessment of personality Budassi). One can make an assumption that it testifies to the aspiration for leadership by applying aggression towards other people.

In a group with medium self-esteem, rigidity is the prevailing condition. Perhaps, these results indicate about difficulty in changing the subject's intended activity in conditions that require its restructuring.

Based on the results of the method of self-assessment of mental states, it was found that frustration is the prevailing state in a group with low self-esteem. Probably, this mental state is dominant, it can arise even as a result of imaginary interference, preventing the achievement of the goal.

Thus, self-esteem - the idea of yourself, about your strengths and weaknesses of personality, also the adequacy of self-esteem affects the effectiveness of adaptation in a social environment. Self-esteem has a positive orientation (only 20% of subjects have an understated level of self-esteem) in students of youth, and that it is associated with the prevailing mental state of the individual.

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**Аннотация.** Статья посвящена изучению самооценки юношеского возраста. В работе анализируются особенности самооценки, а также ее связь с психическими состояниями личности.

**Ключевые слова:** самооценка, психические состояния, уровень притязаний.

**Summary.** The article is devoted to the study of self-esteem of youthful age. The paper analyzes the features of self-esteem, as well as its relation with the mental states of the individual.

**Keywords:** self-esteem, mental states, level of claims.

## **FEATURES OF STRESS RESISTANCE OF STUDENTS- METROLOGISTS**

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At present, work with stress is gaining more and more pace. Various methods are developed, some become relevant and some do not find a place in the modern stage.

Stress is a mental state of general excitement, psychic stress while working in difficult, unusual, extreme situations; nonspecific reaction of the organism to sharply changing environmental conditions [1].

Stress-resistance is a set of personal qualities that enable a person, particularly a specialist, to resolve stressful situations successfully, to get through stress, that means significant intellectual, strong-willed and emotional loads (overloads), which are due to the peculiarities of his life activity, particularly professional activities, without any special harmful consequences for the activities, other people and his health.

The term "stress" is often used very freely. It is used in medicine, physiology, sociology, psychology and other sciences. By type stresses are divided into systemic stresses that arise from poisoning, bruises, etc. and mental stresses that occur with the affection of the emotional sphere.

G. Selye distinguishes three stages of development of stress: the first stage is the stage of anxiety; the second stage is the stage of resistance; the third stage is the stage of exhaustion [1].

The stressful situation for each person has its own individual perceptions: the presence of specific stress factors is not a condition for the development of stress as a nonspecific reaction of the human body. In fact, the threat to life or the imaginary threats have the same stressful power. To study human behavior in a threat situation, psychologists introduced the concept of stress resistance as a set of personality traits that enable a person, particularly a specialist, to resolve stressful situations successfully, to transfer stress, i.e. significant intellectual, strong-willed and emotional loads

(overloads), which are due to the peculiarities of his life activity, particularly professional activity, without special harmful consequences for activities, other people and his health [2].

This research will help to identify the features and levels of stress resistance of metrologists, as this subsequently will help to fulfill their professional duties, be prepared for any non-standard situations.

For our empirical research, the 2nd year students of the specialty "Metrology" of the Sevastopol State University were interviewed. There were used methods of perceptual evaluation of the type of stress-resistance (the authors of the methodology distinguish three types of behavior in an extreme situation: Type B: people of this type clearly define the goals of their activity and choose the optimal ways of achieving them; they try to cope with difficulties themselves, they analyze difficulties and their occurrence, make the right conclusions, can work with a great deal of effort for a long time, they are able and aspire to distribute time rationally. People of the types A and B are called "situational stress resistance", and the people of type A are characterized by the tendency to contention, achieve the goal, they are usually dissatisfied with themselves and circumstances and begin to rush to a new goal) and the projective technique "Do not let a man fall" which allows to identify the features of behavior in force major situations on the basis of the principles of integral psychology [3].

Of the 9 people tested on this technique, only one person is of type "B". The remaining 8 people are of type "A", which indicates the instability of students' behavior in an extreme situation.

The projective method "Do not let a man fall" allows on the basis of the principles of holistic psychology to identify the features of behavior assessed in stress, force major situations (picture 1).



Picture 1. Pictures of students, projective methodology "Do not let a man fall"

Estimated completes the drawing, which a bluff and a person, whether falling, or jumping from it is depicted. He must save the person from imminent injury, not let him fall. On the drawn plot conclusions about the possible behavior of a person in a critical situation are drawn. The following results were obtained:



- 12% of the respondents drew wings to the falling person; it shows that he always finds a smart way out of a difficult situation;

- 22% of the respondents turned a bluff into a small hill, stopping by that the fall of a person, it means that he has leadership qualities and is able to lead people behind him. In a critical situation, he will not lose and will do everything necessary to correct what has happened.

- 11% of the students drew a man with arms outstretched, ready to catch the falling into his embrace, it means that he is imprudent and trustful, in a critical situation he is inclined to trust anyone. He is not able to find a way out of the impasse independently and looks for someone who would help him. But since the estimated is not very well versed in people, he is often deceived and brought down.

- 22% of the students drew water under the feet of a person (river, lake, sea), it says of the inclination to let things go by themselves. Often, brings the situation to a critical state himself, without taking any steps to resolve it. He is idle at times when he must be active and determined and take the bull by the beard.

- 33% of the future metrologists drew a trampoline or a stretched blanket under the feet of a person to soften the fall and catch a person, this indicates foresight. He very rarely gets into critical situations, because he always carefully counts all possible variants of the development of events and tries to predict everything that can happen. But even if the estimated does not take into account something, he will always have a ready remedy to save the situation. You can rely on estimated, he will not let you down.

So, thanks to a small empirical research, the peculiarities of the behavior of the students meteorologists in a stressful situation were revealed. Most students show situational stress-resistance and the variety of behavioral responses in such situations. This suggests that it is necessary to conduct additional sessions on the formation of stress-resistance of future engineers.

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**Аннотация.** В статье рассмотрены теоретический аспект проблемы стрессоустойчивости и выявлены особенности

стрессоустойчивости у студентов-метрологов.

**Ключевые слова:** стресс, стрессоустойчивость, методика.

**Summary.** The theoretical aspect of the problem of stress-resistance is examined in the article and the features of stress-resistance in students-metrologists are revealed.

**Key words:** stress, stress-resistance, methodology.

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## **STUDENTS PERCEPTION OF 2018 RUSSIAN PRESIDENTIAL ELECTION POLITICAL ADVERTISING**

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We can't imagine life in the 21st century without advertising. We are used to seeing diverse billboards, signs, and commercials tempting us to buy the advertised goods, watch advertisements on television, listen to it on the radio.

Psychology of advertising is a special section of psychology that deals with assessing the needs or expectations of consumers, developing psychological means of influencing people with the aim of creating demand for the goods to be sold [4, p. 24].

Advertising is a unique way of influencing people intended for persuasion. It affects the behavior of a person motivating him to buy an advertised product, and as a result the person begins to like this product" [4, p. 19].

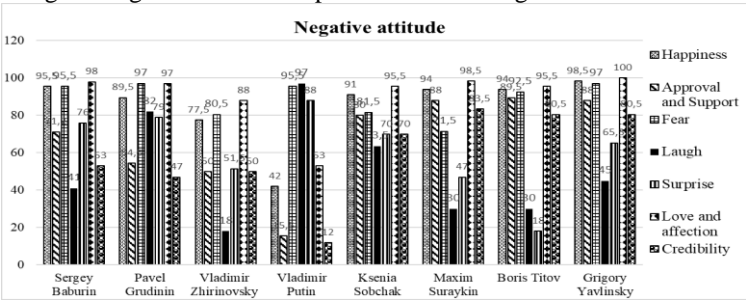
Marketing experts Denis Beslatnyj, Jean-Jacques Lambin, Evgeniy Golubkov argue that advertising must necessarily sting to the quick and cause people to have strong emotions.

On March 18, 2018 significant elections were held in Russia. The Crimea and Sevastopol participated in the RF Presidential elections for the first time after the Crimea and Russia reunion. Numerous studies state the

political nihilism of today's youth: the reluctance to go to the elections, the neutral position. Therefore, it would be interesting to study the emotional response of students to the political advertising of the presidential candidates.

An empirical study has been conducted among 66 second-year students of Sevastopol State University. Pre-election campaigning of the candidates has been studied. We singled out some of the strongest emotions that a person feels when watching such electoral advertising, namely: happiness, approval and support, fear, laughter, surprise, love and affection. We were trying to answer the question: "Is electoral advertising convincing or not?" We divided all emotions into three groups according to the attitude of the responders: negative, positive, and neutral. The results of the survey are presented in figures 1, 2, 3.

Fig. 1. Negative attitude to political advertising



Negative attitude prevails in most commercials. It is seen that in most cases the responders have not experienced such emotions as approval and support (the highest scores), happiness, love, and affection. The above diagram shows that the electoral advertising was not convincing. Neutral attitude does not have such high indicators as negative ones. However, the percentage of credibility is high. This fact suggests that the advertising has not produced proper impression.

Fig.2. Neutral attitude to political advertising

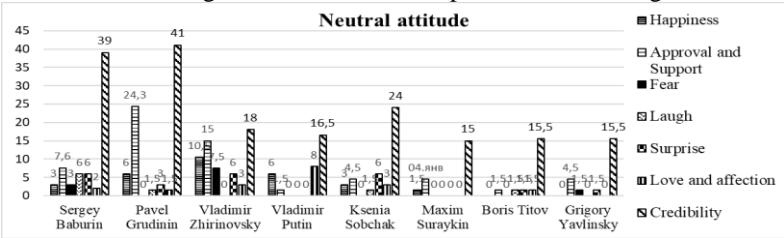
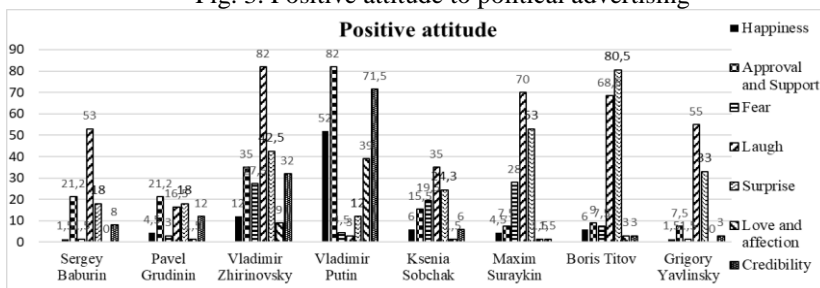


Fig. 3. Positive attitude to political advertising



Positive attitude has high indicator in such emotions as laughter and surprise. However, these emotions are not always a sign that the consumer will choose this particular product. Such emotions can be both with the sign “+”, and r “-”.

According to the results of our research the most vivid and convincing electoral advertising has been created by Vladimir Putin’ election staff. Electoral advertising of Boris Titov (the Party of Growth) has got the most negative attitude, and advertising of Ksenia Sobchak (Civil Initiative) has not been taken seriously by the majority of students who were grinning and giggling while interviewing.

Summing up we can say that despite the fact that most electoral advertising had negative coloring, these kinds of emotions still "cling" to the consumer and always find their audience.

And in conclusion, we can say that the aim of any advertising campaign is manipulation a voter’s decision. Manipulation is always carried out in secret, it is hidden from the awareness of its subject otherwise no one in his/her right mind will agree to perform any action against their will and choice.

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**Аннотация.** В статье рассмотрены особенности восприятия студенческой молодежью политической рекламы, используемой на выборах президента Российской Федерации 2018 года. Проведенный опрос выявил эмоциональные отклики студентов на политические лозунги выборов 2018 г. и определил наиболее привлекательную и наиболее отвергаемую политическую рекламу с точки зрения ее восприятия.

**Ключевые слова:** политическая реклама, восприятие, молодежь, эмоции.

**Summary.** Students' perception of political advertising used at the RF Presidential elections in 2018 has been considered. The survey has revealed students' emotional responses the political slogans of the 2018 Russian elections and determine the most attractive and the most rejected political advertising from the point of view of its perception.

**Key words:** political advertising, perception, youth, emotions.

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## **SPECIFICS OF LEADERSHIP STATUS IN THE STUDENT'S GROUP**

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The identification of leadership styles in the process of the activities of various groups is becoming an increasingly urgent topic. In different organizations, societies, campaigns, there must be a person who can unite people, give necessary instructions, resolve problem situations and offer the necessary, effective solutions for overcoming them. But, so that the result in the process of joint work was really effective, the leader did not cease to be respected and did not lose confidence his confidence, and the atmosphere in the team was friendly, it is necessary to know what styles of leadership can be. The leadership theory of Kurt Lewin can be a useful source of knowledge of this topic, which will be discussed in this article.

Leadership is the main position and the responsibilities of the leader - the head of the organization. The leader's main goal is to influence on the

environment to achieve the set goals and objectives in the course of joint or individual activities.

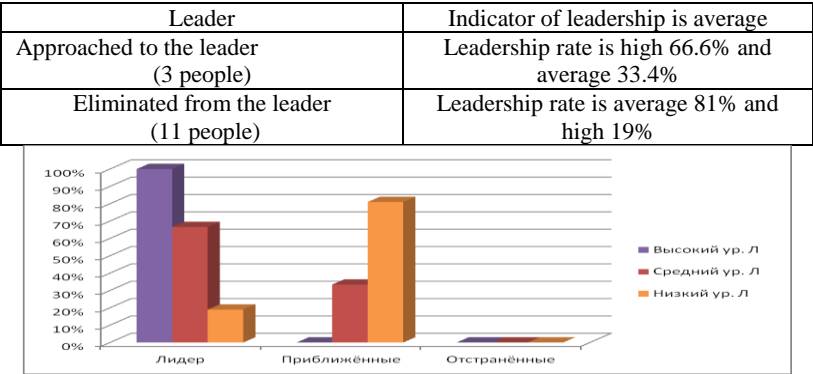
Leadership style is the leader's way of working with the participants of the process, to influence on them in order to achieve the goals and objectives and gain results.

To study leadership abilities, there was a survey conducted for 15 female students aged from 18 to 21 years who are taught at the department of "National philology". In the empirical research, two methodologies were used: the methodology for diagnosing the leadership abilities of E. Zharikov and E. Krushelnysky and also the sociometry method for revealing the group status of the individual.

The respondents had the following features: 33% had a low level of leadership abilities, 53% had an average level, and 13% had a high level.

According to the results of the sociometry, it turned out that the leader, according to the group status of the individual, is number 5, but his personal leadership indexes indicate an average level of leadership. Approached to the leader numbers 1, 6 and 14 are with different levels of leadership abilities. So, in the number 1 personal indicator is a high level of leadership, and the 6 and 14 is an average level of leadership. Apart from the leader are the numbers 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 15. Among them, the average level of leadership prevails, based on personal indicators, and in number 3 the personal indicator is radically opposite to the leader's group status of the person, in which number 3 is located, and this indicator is a high level of leadership. so, it should be noted that a person with leadership qualities does not always show himself as a leader and, conversely, a person who does not personally consider himself as a leader, is a leader according to the group status of the individual (Table 1, Picture 1).

Table 1 / Picture 1. Students with different group status of personality and leadership abilities



Picture 1

So, thanks to our small empirical research, the leadership abilities of female philology students were revealed and compared with the group status of the individual. Interesting data were received: not always the presence of leadership abilities contribute to the leadership position in the group and vice versa.

That is why it is important for a group of people to have a leader who will unite participants, strengthen the team, guide them in the right direction, give advice, help solve problems, identify new methods and ways of achieving goals.

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**Аннотация.** В статье представлены теоретические основы лидерства как группового феномена, а также изучены особенности лидерских способностей у студентов-филологов с различным групповым статусом. Как показывает наше небольшое эмпирическое исследование, студенты с высоким и средним уровнем лидерских способностей не всегда проявляют себя в группе.

**Ключевые слова:** теория лидерства, стили лидерства, лидерские способности, групповой статус личности.

**Annotation.** The article presents the theoretical foundations of leadership as a group phenomenon and the characteristics of leadership abilities among students with a different group status. As our small empirical research shows, students with a high and medium level of leadership abilities do not always manifest themselves in group.

**Keywords:** leadership theory, leadership styles, leadership skills, group status of the individual, group status of the individual.

UDC 378

## **INNOVATIVE METHODS APPLICATION IN MATHEMATICAL DISCIPLINES EDUCATION IN TECHNICAL UNIVERSITY**

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Rapid scientific and technological progress, informatization and computerization of society, the emergence of new production technologies, the development of information and communication technologies require highly qualified engineers who are able not only to work on new modern equipment, but also to modernize it and create new ones; professionals who can quickly adapt to new conditions in the workplace and the world. Training of technical specialists is one of the most important national tasks and education system. It develops a production, science and technology, creates the foundation for the welfare of the people and their independence.

In order to train highly competitive engineers it is necessary to provide a proper level of students' mathematical knowledge, because mathematics plays an important role in the formation of such qualities of a modern specialist as abstract thinking, ability to build logical chains, find approaches to solving non-standard problems. Mathematics is the language of engineering research and calculations, the basis for the study of physics, astronomy, chemistry, general technical and special disciplines. Mathematical methods and mathematical modeling are widely used for solving practical problems in various fields of science, technology and economics.

Skill in mathematical culture contributes to the improvement of the engineering mind of the specialist and provides: the ability of holistic perception of the object, open qualitatively new connections and relationships, the effectiveness of the insights during the final effect: [3, p. 39].

Use mathematical problems in educational process develops such qualities of engineering as thinking, flexibility, the ability to support their judgments and draw conclusions, to choose the optimum methods to achieve the objectives [4, p. 319]. The gradual complication of problematic tasks in the educational process makes it possible to make the transition from preliminary search actions to productive and creative. Developing thought processes, mathematics is actively involved in the formation of the creative potential of the student. Problem-based learning encourages students to think actively in lectures and practical classes, conducting them in the form of discussion, debate, which contributes to creative work through more accessible communication with students.

The specificity of any engineering specialty is the ability to analyze the properties of the data given graphically, to find the relationship between the values. Successfully delivered by the teacher question on the problem "brings" the students to partially independent solution, as well as proposals for solutions. The teacher can point to a more rational method. Therefore, it



is possible to organize training as an interesting process, if it uses elements of creativity.

Block of mathematical disciplines is designed to perform two general functions in the mathematical training of engineers: general education and professional. The essence of innovative training is that the teacher organizes educational and cognitive activity of the student in such a way that he, relying on his potential and already gained knowledge, independently solves the tasks. It should be emphasized that the leading functions of innovative training is to focus on the creative interaction between the teacher and the student with a dominant on the initiative of the student, the democratization of education, the introduction and application of new teaching methods, technologies and modernization of the material base [1, p. 28]. The method of pedagogical support in the educational and cognitive activity of students by solving problems that require their own efforts is also important in innovative training.

Among the innovative forms of organization of training can be identified as follows: pair (work of students in conjunction with the teacher, with classmates); frontal (the teacher teaches at the same time a group of students ); group (all students provide training to each other); individual (self-training of students).

Conducting non-standard lessons takes into account age features, interests, inclinations, abilities of each student [2, p. 25]. The most common forms of non-standard employment:

1. Integrated lesson. As a rule, this class is conducted by two teachers. They jointly carry out updating of knowledge in two directions, survey (if necessary), presentation of new material taking into account the successive links of subjects. Most often combined subjects such as mathematics-physics, mathematics-computer science.

2. Research classes and laboratory-practical work. Their purpose is to obtain educational information from primary sources, which contributes to the development of special skills, stimulates cognitive activity and independence of students.

3. Role play. It requires students to make specific decisions in the problematic situation within the role. Each game has a well-designed scenario, the main part of which is necessary to modify the students.

Thus, the introduction of elements of innovative teaching methods brings diversity in the forms of training, which increases interest in the subject, and as a consequence, increases the motivation to learn, which positively affects both the assimilation of the material, the use of knowledge in practice, and the formation of a competent specialist in his profession.

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**Аннотация.** Статья посвящена исследованию проблемы повышения качества математической подготовки студентов технических вузов. Обозначена роль математики в процессе обучения будущих инженеров и важность обеспечения надлежащего уровня математических знаний и умений для подготовки высококвалифицированных конкурентноспособных специалистов. Выделены и проанализированы некоторые ведущие функции и формы инновационного обучения, а также формы проведения нестандартных занятий.

**Ключевые слова:** математическая подготовка, инновационное обучение, студенты, технический вуз.

**Summary.** The article is devoted to the problem of improving the quality of mathematical training of students of technical universities. The author points a role of mathematics in the process of training future engineers and the importance of ensuring the appropriate level of mathematical knowledge and skills for the training of highly competitive professionals. Some of the leading functions and forms of innovative training, as well as forms of non-standard employment are identified and analyzed.

**Key words:** mathematical training, innovative training, students, technical University.

## **THE PHENOMENON OF AGGRESSION IN PSYCHOLOGICAL SCIENCE**

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In the modern world, the problem of aggressive behavior is actual, it increases every year. Aggression was the cause of increased cruelty, which manifests itself both on the street, at home, and at the educational institution in relation to the people who are nearby. It contributes to the emergence of problems both in the socialization of the individual in society, and in the sphere of education and work. A person loses the opportunity to build good relationships with peers and adults, acquiring a misunderstanding on their part. Excessive manifestation of negative emotions, namely aggression, can further contribute to the development of various neurotic disorders and deviation in the full development of the personality.

Aggression (from Latin *aggressio* – attack) – is motivated destructive behavior, which contradicts the norms of coexistence of people, which harms the objects of attack, causing physical, moral damage to people or causing them psychological discomfort [1].

Unfortunately, analysis of the literature has shown that there is no one clear definition of aggression and aggressive behavior both in domestic psychology and in foreign psychology. This suggests that aggression means for each something different. For example, one person describes an aggressive person because of his unfriendliness, and another understands aggression only as a manifestation of physical actions towards another person. According to the definition of A. Bass, who said that aggression is a reaction, as a result of which the other body receives painful stimuli [2]. Hence it can be said that manifestations of aggression in people are diverse and endless. In his opinion, aggressive actions can be described using three scales:

- physical – verbal;
- active – passive;
- straight line – indirect.

Their combination gives eight categories that describe aggressive actions [3]. For example, one person's physical abuse of another can be classified as physical, active, and direct. But on the other hand, the expression of negative feelings through verbal responses (threats, abuse) can characterize verbal, active and indirect.

This opinion is held by R. Baron and D. Richardson who believe that aggression, in whatever form it manifests itself, is behavior aimed at causing harm or damage to another living being who has every reason to avoid such treatment with himself [4].

From the above, we can recall that we observe almost every day the manifestation of any form of aggression, being on the street or in any institution. After all, people no longer notice this, and may not even realize their actions. If there is no awareness, then we can assume that aggression is driven by human instincts. Actually, the psychoanalytic trend speaks of aggressive behavior as an instinctive one.

According to Z. Freud, the behavior comes from the instinct of life, whose energy is directed at strengthening, preserving and reproducing life. Aggression was considered as a reaction to the blocking or destruction of libidinal impulses.

But Freud proposed the existence of the second basic instinct, *thanatos* – the desire to die, whose energy is directed toward the destruction and cessation of life. Freud believed that all human behavior is the result of the complex interaction of this instinct with *eros* and that there is a constant tension between them. In view of the fact that there is an acute conflict between the preservation of life (*eros*) and its destruction (*thanatos*), other mechanisms (for example, displacement) serve the purpose of directing *thanatos* energy outward, in the direction of the 'I'. Thus, *thanatos* indirectly contributes to the fact that aggression is withdrawn and directed to others.

According to Freud's opinion, if aggression is not released outside, then this energy will be directed at itself, which helps to self-destruct the individual. Hence it can be concluded that each person has his own amount of energy of *thanatos* and he himself decides at the expense of what actions he should release this energy, whether it be verbal aggression (crushing), or physical (impact struck man or inanimate object).

Unlike others, the theory of social learning was that aggression is behavior that has been assimilated in the process of socialization through observation of a certain mode of action and social reinforcement. That is, a person is guided by a pattern.

This theory was proposed by A. Bandura and explained the assimilation, provocation and regulation of aggressive behavior. From his point of view, the analysis of aggressive behavior requires taking into

account three points:

- ways of mastering such actions;
- factors that provoke their appearance;
- the conditions under which they are fixed.

Thus, a person from childhood watching an adult or authority, to which he wants to be similar, repeats the same aggressive action that is subsequently fixed to him and subsequently manifests itself. Often this happens with the help of parents who by their example, without realizing it, can teach the child the manifestation of aggression. After such training, being in the group of his companions, the child will begin to show aggressive actions towards another person or living creature, and if there is encouragement from the comrades (reinforcements), then the process of such aggressive manifestation will be difficult to stop in the future .

Thus, after analyzing several approaches to the emergence of this phenomenon, we see that the problem of aggression is still relevant. It cannot be said that there is only one factor contributing to the manifestation of aggression, each individual has his own reasons for the liberation of aggression. After all, for each person, aggression is understood in different ways, it can depend on worldview, upbringing and the like. But if you study aggression well, you can presumably understand why it arises; hence you can direct it to a socially-approved channel, which will lead an individual to a harmonious and happy life.

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**Аннотация.** Статья посвящена теоретическому анализу феномена агрессии. Рассмотрены понятия агрессии, подходы авторов на изучение агрессии, возможные причины, способствующие ее проявлению.

**Ключевые слова:** агрессия, агрессивное поведение, индивидуум.

**Summary.** The article is devoted to the theoretical analysis of the phenomenon of aggression. The concepts of aggression, the authors' approaches to the study of aggression, possible reasons contributing to its manifestation are considered.

**Key words:** aggression, aggressive behavior, individual.

## **FUTURE NAVIGATORS READINESS FORMING FOR INTERCULTURAL COMMUNICATION IN ENGLISH LANGUAGE**

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Teaching intercultural communication in English is a set of teaching principles, including guidelines on methodology and a programme that focuses on meaningful communication. With this approach, students are invited to complete the task with the help of a language, rather than learning a foreign language [9].

It is known that English was adopted by IMO as the official language of the sea [7]. And STCW-95 (international Convention on standards of training, certification and Watchkeeping for seafarers) requires that every seafarer has a sufficient level of English proficiency [8]. At present, the legislation emphasizes the importance of fluency in English with regard to Maritime safety.

Analysis of the Federal State Educational Standard of Higher Education in 26.05.05 "Navigation" (the level of specialization) showed that among the necessary skills are the following:

- ability to communicate orally and in writing in Russian and foreign languages to solve problems of interpersonal and intercultural interaction (GC-6) [6];
- willingness to communicate orally and in writing in Russian and foreign languages to solve problems of professional activity (GPC-2) [6];
- proficiency in English to the extent necessary to carry out their duties (PC-18) [6].

Questions of formation of readiness for foreign language communication of students of University were considered by N.V. Yankina, L.B. Nikolaeva. Formation of foreign language communicative competence studied O.A.Leskina, A.V. Protchenko, V.F. Aitov, A.P. Vasiliev. Training interlingual communication through scientific text was considered by E S. Mousa [3]. However, modern forms of training for formation of readiness for intercultural communication in English at future skippers were not a subject of special consideration.

Thus, the purpose of this article is to study the main aspects of the formation of readiness for intercultural communication in English communication in oral and written forms in future skippers in high school. The object of research is the educational process of the university. The

subject of the research is the main aspects of the formation of readiness for intercultural communication in English among future skippers.

The preparation of future skippers for intercultural communication should start with the enhancement of social competence. For formation of readiness of future skippers for intercultural communication in English the corresponding language competence that assumes formation of communicative abilities in the course of studying of foreign language is necessary. Future boatmasters are required to have communication skills within the subjects prescribed by IMO:

- Ask for and give personal data and describe crew roles and routines;
- Name types of vessel; describe parts of a vessel;
- Name positions on board; ask for and give directions on board and ashore;
  - Describe the location and purpose of safety equipment;
  - Discuss navigational routes and geographic locations; understand standard helm orders; use numerical information for engineering;
  - Describe routine operations on board; describe watchkeeping duties; understand standard engine orders;
  - Report events from past voyages;
  - Understand commands in emergency situations on board;
  - Check supplies; provide quantities, weights and prices; discuss cargo handling procedures; report damage to cargoes;
  - Compare vessel details; describe equipment and describe visitors on board;
  - Describe weather conditions; understand forecasts;
  - Report incidents that occurred at sea; simulate VHF communications for distress and urgency messages and explain personal injuries at sea; request medical assistance;
  - Check task completion in routine operations; VHF communications regarding bunkering;
  - Produce external written and spoken communications to request and give advice and discuss future events; negotiate future plans [8].

The formation of readiness for intercultural communication in English among future skippers is achieved as a result of the interaction of the main components of readiness: the desire and ability to interact.

The main ways of improvement of formation of readiness of future navigators to cross-cultural communication are in using modern principles of foreign language teaching (principles of an intercultural approach).

The principles of foreign language teaching are as follows 1). Intercultural principle: an activity that involves real communication that promotes learning 2). The target principle: activities in which language is

used to transmit the main tasks of the 3). The principle of meaning: a language that makes sense to the learner supports the learning process [9].

The purpose of the discipline "Foreign language" is to increase the initial level of foreign language proficiency, achieved at the previous stage of education and mastery of students necessary and sufficient level of foreign language communication to solve social and communication problems in various fields of domestic, cultural, professional and scientific activities in communication with foreign partners, as well as for further self-education. The study of a foreign language is also intended to provide: development of information culture; expansion of horizons and increase the General culture of future ship mechanics.

The final goal of the discipline "Foreign language" is a formation of the ability and readiness for intercultural communication-determines the communicative orientation of the course, which involves achieving a certain level of communication in a foreign language, which means the ability to correlate language tools with specific goals, situations and tasks of speech communication.

The final result of the discipline "Foreign language" implies: the availability of language competence sufficient for further educational activities, for further study of foreign experience in a particular field, as well as for business contacts at an elementary level; the ability to conduct a conversation in a foreign language – a dialogue of a general nature, comply with the rules of speech etiquette, read literature in the specialty without a dictionary in order to find information, translate texts in the specialty with a dictionary, make annotations, abstracts and business letters.

Therefore, in order to improve the skills of oral and written speech in the field of professional marine English, it is advisable to expand the content of foreign language teaching through specific training material – workshops to practical exercises and independent work for cadets. Also, these educational publications (workshops) are designed to develop the skills of reading literature in the specialty and the formation of skills of professional oral speech of cadets specialty 26.05.05 "Navigation", contain information necessary for business communication in English for skippers with foreigners on issues related to documentation used in cargo transportation by sea vessels, loading and unloading in ports, etc.

Topics for learning a foreign language for future skippers may be: "Ship's crew", "Ship's construction", "Types of the ship", "Life-saving equipment", "Navigational routes", "Geographic position", "Free time", "In the messroom", "Ordering provision", "Main Technical Characteristics of Ships", "Deck Cargo Handling Equipment", "Fishing Operations", "Types



of Cargo”, “Essentials of the Maritime Conventions”, “Safety on Board”, “Watchkeeping” [2, 4, 5].

The practical textbooks provide authentic text materials in English, selected from original sources, namely the IMO conventions, popular scientific literature, which helps students to learn the necessary modern terminology, grammatical aspects of documentation and ultimately improve their professional competence.

One of the modern methods of active social training of students of intercultural communication in order to form their main components of readiness are methods of active involvement in the situation of intercultural communication: discussions, games, situation analysis, training, allowing you to immerse yourself in the active controlled communication [10]. It is active methods of intercultural learning-simulation and business games allow you to get acquainted with the problems in the dynamics. Interactive training is based on the subject's reflexive interaction with the educational environment [1]. An example of tasks at the initial stage of training can be the following:

Work with a study partner. Ask questions and complete the form. Introduce your partner. A new engineer arrives on your vessel. Imagine you are talking to him. Complete the dialogue [4].

Thus, in conclusion, we note that the methods of active social training of students in intercultural communication, which we have considered, contribute to the formation of their basic components of readiness for intercultural communication in English.

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**Аннотация.** Актуальность данного исследования определяется тем, что законодательство подчеркивает особую важность владения английским языком в отношении безопасности на море. Проведен анализ ФГОС ВО специальности 26.05.05 «Судовождение» (уровень специалитета). Цель данной статьи является исследование основных аспектов формирования готовности к межкультурному общению на английском языке у будущих судоводителей в вузе.

**Ключевые слова:** готовность, межкультурное общение, английский язык, судоводитель, Международная Конвенция, межкультурный подход.

**Summary.** The relevance of this study is determined by the fact that the legislation emphasizes the importance of English proficiency in relation

to safety at sea. The analysis of Federal state educational standard of higher education in the specialty 26.05.05 “Navigation” (specialist’s degree programs) was presented. The purpose of this article is to study the main aspects of readiness forming of intercultural communication in English language in future navigators at the university.

**Key words:** readiness, intercultural communication, foreign language, navigator, International Convention, intercultural approach.

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## **THE SPECIFICITY OF THE EMOTIONS IN PSYCHOLOGICAL SCIENCE**

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In psychological science, much attention is paid to emotions, since they are an integral part of the life and activity of any person.

The purpose of the article is to consider the concepts of emotions in psychology and their types and psychological characteristics.

Emotions are the reactions of a person to the effects of various external stimuli, which reflect in the experiences their personal significance to the person and are expressed in the form of pleasure or displeasure. Human emotions affect the personality, his family, social status for life as a whole. A person cannot live without emotion, as this is an important component in the life. When people satisfy every need – as a result they experience emotions, whether it is joy or sorrow. It means that any need can cause different emotions and any emotion can cause different needs.

Many people believe that anger, fear, shame are negative emotions. But this statement is wrong. These emotions cannot be called unambiguously negative, because in some situations they can be as useful (positive) as harmful (negative).

Emotions are always individual; we will never meet a person who will react to any object or event in the same way as we do. Such emotions allow us to assess everything that is happening around us and inside us, and no matter how people are similar to each other, their emotions will be different.

Ideas about emotions and their functions in human and animal life have been a major theme in philosophy since the time of the ancient Greeks, and more recently in psychology and social sciences. The history of ideas about emotions is an integral part of the history of human nature. The history of emotions plays a particularly controversial role in the history of gender and cultural life. Are women 'more emotional' (and therefore less rational) than men? Are the Greeks more emotional and less rational than 'the barbarians' or the British?

Even in ancient times, scientists began to be interested in emotional states. Alkmeon, Democritus, Plato, Socrates wrote in their works about the 'state of the soul' of a man, due to the influence of internal and external factors.

Further, for many scientists, emotions have become the object of attention. There were many theories and concepts on the topic of 'emotions'.

S. L. Rubinstein wrote that emotion is a mental representation of the actual state of the need. According to A.N. Leontiev, emotion is a mental representation of the meaning, which forms the motive. E. P. Ilyin believed that emotions are usually understood as an experience, emotional excitement [4].

Many domestic psychologists: B.I. Dodonov, N.D. Levitov, A.N. Leontiev, S.L. Rubinstein identify the types of emotion, different patterns of behavior and psychological characteristics. The most common is the classification of emotions, highlighting affects, actually emotions, feelings, mood and stress [1].

Affects are strong short-term experiences, accompanied by pronounced motor and visceral manifestations. They appear in response to the actual situation and in this sense are as if shifted towards the end of the event.

The regulating function consists of the formation of a specific experience – affective tracks that determine the selectivity of the subsequent behavior in relation to situations and their elements that formerly caused affect.

Actually, emotions, according to A.N. Leontiev – longer states which manifest themselves in external behavior. They express an evaluative personal understanding of the emerging or probable situations, their own activities and manifestations. They are also able to predict situations and circumstances that will come in the future. They can arise from experiences previously or imagined situations [1].

Feelings are person's experience of his attitude to reality, characterized by relative stability, duration, objective nature. Person's feelings reflect the

structure of his/her personality, revealing its orientation and attitudes. They are formed under the influence of education in society, the family and other social institutions.

Mood is a feeling or individual state of a person at any particular time. Mood is also the predominant emotion that occurs not only in people, but also in literature, music and other expressive arts. The mood sets the overall tone for speech or writing and is an important element both in literature and in everyday life.

When describing how the group feels, a collective mood is often used. For example, if something unfair happens in the workplace and a group of employees lost their job, the mood of that group can be described as frustrated and outraged. If a group of students gets the opportunity to go on a fun field trip for a day instead of being in a stuffy audience, the mood can be described as excited or elated.

For the mood as for the emotional state, the following symptoms are characteristic: 1) weak intensity; 2) significant duration; 3) uncertainty of origin, causes of mood; a person does not realize the dependence of mood on specific situations; 4) the effect on human activity [3].

A special form of experiencing feelings, close in their psychological characteristics to affect, and in duration approaching the mood, are stressful states or emotional stress. Stress is characterized by multiple changes in the body and personality. The leading psychological characteristic of stress is tension. Voltage is accompanied by a change in the intensity of many processes in the body and psyche in the direction of increase or decrease (depending on the individual characteristics of the person) [2, c. 302-303].

Among the most frequent manifestations of stress is a sense of loss of control over oneself, insufficiently organized activity (absent-mindedness, mistaken decisions, fussiness), lethargy, apathy, fatigue, sleep disorders. Species, or components, of emotional stress are anxiety, fear, intrapsychic conflict, crisis, post-traumatic syndrome.

In the psychology of the state, apart from emotions, feelings, affects, stress and mood, the state of frustration is highlighted. Frustration is the mental state of an acute experience of an unsatisfied need. Frustration situations are caused by a conflict between a topically significant need and the impossibility of its realization, a breakdown of motivated behavior. Frustration is characterized by the following signs of negative experiences: frustration, irritation, anxiety, despair. Adaptive behavior is typical for a person who, even under the influence of strong stimuli (obstacles), the state of frustration does not occur. This is a consequence of tolerance, that is, tolerance towards frustrators. If tolerance is low, then the person reacts to frustrators of even a small force with inadequate behavior - aggression, which

can be directed at the alleged culprit of the frustration situation, against himself, to any other person, to others.

Thus, the emotional state of an individual is considered to be a fundamental component in the overall picture of the state of the subject, his emotional feature, which has a great attention to the cognitive, volitional, motivational sphere. Emotional states have physiological basis, are connected with the activity of nervous, digestive, circulatory systems. Emotions have an external expression – emotional expression, which is expressed in facial expressions, gestures, posture, actions of the individual. Emotional state is considered the outcome of the assessment of the situation, achieving the goal, the magnitude of the discrepancy between the desired and achieved.

Currently, the problem of emotions is very relevant because emotions, affecting the body and mind, affect almost all aspects of its existence. Emotions determine the degree of activity of thinking motor activity. Our attitude to people, events, and tasks put forward by life, evaluation of our own actions and actions largely depends on them. Thanks to emotions, we understand each other better. We can, without using speech, judge the state of other people, it is better to tune in to joint activities and communication. Without emotion, that is, without being able to experience joy and sadness, anger and guilt, we would not be fully human. Emotions became one of the signs of humanity. Equally important is our ability to empathize with other people's emotions and empathy. And Augusto Curie wrote: 'Emotional division multiplies happiness.'

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**Аннотация.** В данной статье рассматриваются эмоции и их роль в жизни человека с точки зрения психологии. Были даны различные понятия и рассмотрена классификация эмоций по А.Н. Леонтьеву. Определены разновидности и компоненты эмоционального стресса.

**Ключевые слова:** эмоции, личность, стресс, эмпатия, настроение, фрустрация, эмоциональное состояние.

**Summary.** This article examines emotions and their role in human life from the point of view of psychology. Various concepts and the classification of emotions according to A.N. Leontiev were given. Types and components of emotional stress are defined.

**Key words:** emotions, personality, stress, empathy, mood, frustration, emotional state.

UDC 159.99

## **FEATURES OF THE STUDENT'S CHARACTER: COMPARATIVE CHARACTERISTICS**

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The phenomenon of character is one of the main problems in psychological science. Character – is an individual characteristic of each person, which manifests itself in activity. From the point of view of domestic psychologists, the character is a set of stable individual features of the personality that develops and manifests itself in activity and communication, causing typical features for the individual (A.V. Petrovsky) [4].

The purpose of the article is a theoretical and empirical study of the psychological characteristics of the character of students in different areas of training.

Many foreign and native authors dealt with the study of the characteristics of character and built psychological theories.

One such scientist was Ernst Krechmer (1888-1964). In 1921 E. Krechmer published a work in which he singled out and described the structure of the human body (constitution) and related its features to the type of character. There are four types:

1. Asthenic – this man possessed a fragile physique, tall or medium height, thin limbs, elongated cheeks of the face, a flat chest, narrow shoulders, fatless stomach, but a strongly developed nervous system (type of character – schizotime).

2. Picnic – this person has a dense figure, small or medium height, prone to obesity, with a large belly (type of character–cyclothym).

3. Athletic – this person has a proportionate strong physique, well-muscled, broad shoulders and narrow thighs, medium or high.

4. Diplastic – this person has a disproportionate physique, may have excessive growth.

Carl Leonhard's classification of character was based on their analysis of the style of human communication with surrounding people. Also, K. Leonhard introduced the concept of "character accentuation" into psychology. The accentuation of character is the excessive severity of individual traits of character and their combinations [2]. There are 10 types:

1. hypertensive (hyperactive) – people of this type are sociable, mobile, have facial expressions and gestures, like peer companies, noisy, have a good sleep, flowering appearance, good appetite;

2. dysthymic – people of this type are serious, conscientious, slow. Typical low contactness, slowness of thinking, pessimistic attitude to the future, low self-esteem, often laconic, gloomy, silent, lead a closed way of life. They appreciate those who are friendly with them and willing to obey them;

3. cycloid – characterized by a change in hyperactive and dysthymic states;

4. emotive – this type is related to the exalted, specific features: empathy for other people or animals, emotionality, hypocrisy, responsiveness, timidity, anxiety, impressionable, tearful, relate to events more serious than other people, are fond of nature. Can react sharply on scenes from films where someone is in danger;

5. demonstrative – characterized by liveliness, activity, demonstrative behavior, easily establishes contact, has a tendency to pretend, fantasies, artistry, can embellish their person;

6. excitable – characteristic features: weakened control, inadequate controllability, anger, rudeness, increased impulsiveness, propensity to conflict situations, rudeness, low contact, indecisiveness in the team, often changes the place of work. Lives real, indifferent to the future;

7. stuck – characteristic features: distrustfulness, jealousy, alertness, suspicion, moderate sociability, moderate sociability, sensitivity to grief and resentment, often initiates conflict, shows great persistence in achieving its goals;

8. pedantic – characteristic features: special attention is paid to cleanliness and order, conscientious, long experiences traumatic events, rarely enters into conflicts, reacts strongly to disturbance of order, attentive,



accurate, punctual, always follows the plan, is prone to doubts about the correctness of the work done, is inferior leadership to other people;

9. anxious – characteristic features: self-doubt, fearfulness, self-criticism, shyness, friendliness, low contact, people of this type are often afraid of the dark, remain alone, shun noisy big companies, hard to survive control and examinations, do not tolerate ridicule, often do not know how to stand up for themselves, seek support and support in conflict situations;

10. exalted – characteristic features: smile, brightness and sincerity of feelings, easily get excited by joyful events, have a high degree of contact, in conflict situations they can occupy both active and passive positions, are attached to friends and relatives, easily pass from a state of ecstasy to sorrow.

This problem is especially acute in adolescent and youth (student) age. The student's age is the age of the formation of independence, the problem of choice, the establishment of one's own views and opinions with respect to oneself and the world around him, the personality at this age strengthens his intellectual and physical abilities. Sensitive period for the formation of value orientations [1].

The second period of adolescence or the first period of maturity, which are characterized by features of personality traits and personality characteristics coincide with the time of study in higher education institutions [3]. The first stage is the admission to a higher educational institution, young men and women are assessed their abilities, a belief in themselves and their strengths is formed; a plan for a future is being built. A positive or negative overcoming of this stage is a significant contribution to the development of the personality, as a result there is confidence or insecurity, further disclosure or suppression of one's potential.

The choice of profession also affects the characteristics of the character in adolescence. If you chose the profession of a psychologist and your choice was conscious, you underwent certain personality tests from a school psychologist, were interested in this profession, and have an idea of what psychology is. Your choice is argued by your preferences, inclinations, and features of thinking.

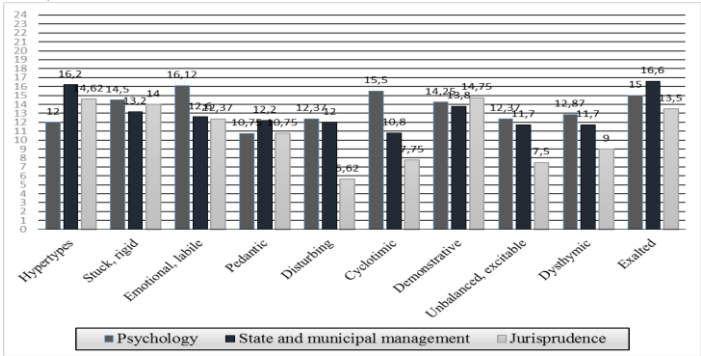
Thus, the student's age is an important stage in the formation of the personality of each person. In this period, special attention should be given to the formation of character as a personal characteristic of professional preferences.

For empirical study of the peculiarities of accentuation of the nature of students, an empirical study was conducted, in which 26 students (10 boys and 16 girls) attended Sevastopol Economic and Humanitarian Institute of Federal Crimean University by Vernadsky in the direction of training:

‘Jurisprudence’ (8 people), ‘Psychology’ (8 people), ‘State and municipal government’ (10 people). The study was conducted in 2016-2017.

It is assumed that the characteristics of the character of the student have significant differences and depend on the direction of preparation in higher education by the example of students - psychologists, lawyers and students in the direction of ‘State and municipal government’.

For an empirical study of the features of character accentuations, the method of determining the accentuation of the character of K. Leangard was used, as well as the nonparametric statistical criterion of the Mann-Whitney U test, for comparisons of the group of students in the following areas of training: ‘Psychology’, ‘Jurisprudence’, ‘State and municipal management’ (picture 1).



Picture 1 – the average of the results of the test of accentuations of the character K. Leangard in the samples

According to the received data of the descriptive statistics, the students who are studying in the direction of preparation ‘Psychology’ have a pronounced ‘emotive’ character accentuation (mean value is 16.12); on the second place – ‘alarming’ type (average value – 15.5) accentuation of character, as the emotional component of psychologists is pronounced and is an important professional characteristic.

Students who study in the field of training ‘Jurisprudence’ are shown a ‘demonstrative’ character accentuation (mean 14.75), due to the choice of professional activity (the profession of a lawyer has a representative prestigious character); ‘Hypertensive’ character accentuation (mean 14.62) – the desire to be a leader, lead people, the need to be in the center of attention.

Students studying in the direction of ‘State and municipal management’ also identified a ‘hypertensive’ character accentuation (mean –16.2), which is expressed in the desire to develop leadership qualities, be included in management activities.

Unexpressed character accentuations for respondents on the following scales:

- future psychologists do not express the character accentuation on the scale of ‘pedantry’ (average value is 10.75), since the students are not fully immersed in educational activity, they do not yet have the ability to properly organize their workplace;

- the future lawyers do not express the character accentuation on the ‘anxiety’ scale (average value is 5.62): this is due to the fact that students feel comfortable in the academic activity in the university, in the group of fellow students, good relations with teachers have been formed;

- students of the ‘State and Municipal Administration’ did not present the accentuation of ‘cyclotimicity’, as students expressed professional characteristics as stability, flexibility and assertiveness of behavior.

Thus, according to empirical research, we have identified that the type of character accentuation has its own characteristics depending on the direction of preparation. To confirm the hypothesis, we used the method of mathematical statistics for independent groups of the U-Mann-Whitney test.

Comparing two samples of psychologists and lawyers on the ‘anxiety’ scale, we found out that the hypothesis was confirmed (at  $U = 14$ ;  $p \leq 0,05$ ), the values are in the zone of significant differences; when comparing future psychologists and lawyers on the scale ‘cyclotimicity’, significant differences were revealed (at  $U = 8$ ,  $p \leq 0,01$ ), which indicates the pronounced differences, which once again prove the personal differences in the chosen professional activity at the stage of mastering the profession.

Thus, significant differences in anxious and cyclotomic character accentuation among students-psychologists and lawyers were singled out, which indicates professional benchmarks that determine the type of personality, in particular, character accentuation as a core characteristic of the subject.

This paper considers only one aspect of the phenomenon of character. In our opinion, it would be interesting to compare the characteristics of character among students of humanitarian and technical specialties, which will become the prospect of our study.

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**Аннотация.** Статья посвящена вопросам изучения феномена характера в психологической науке (на примере обучающихся в вузе). В работе рассмотрен вопрос особенности типа акцентуации характера по Г. Леонгарду у студентов гуманитарных направлений подготовки. Выявлены значимые различия по тревожной и циклотимной акцентуации характера среди студентов - психологов и юристов, что свидетельствует о профессиональных ориентирах, которые формируются на основе типа акцентуации характера.

**Ключевые слова:** характер, студент, акцентуация характера, К. Леонгард, характера, типы.

**Summary.** The article is devoted to the study of the phenomenon of character in psychological science (on the example of students in the university). In the paper, the question of the type of character accentuation according to G. Leongard in students of humanitarian training areas was considered. Significant differences in the alarming and cyclotomic accentuation of character among students – psychologists and lawyers – have been revealed, which indicates professional orientations that are formed on the basis of the type of character accentuation.

**Keywords:** character, student, character accentuation, K. Leonhard, character, types.

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## **STRESS AND COPING STRATEGIES OF STUDENTS-FUTURE ENGINEERS IN THE FIELD OF ENERGY**

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Modern researchers pay special attention to the identification of determinants of resistance to mental stress, its manifestations in educational activities, as well as the role in the professional development of a young specialist. This is reflected in the works of both domestic and foreign authors: K.K. Platonov, O.Y. Chernikova, L.A. Kitaev-Smyk, V.A. Bodrov, L.I. Antsiferova, S.V. Subbotin, O.V. Logacheva, R. Lazarus, S. Folkman [3].

The study of the phenomenology of stress resistance, ways and means of forming, maintaining, depending on its characteristics of professional activity is important for employees of the organization, whose activities often take place in a dynamically changing environment.

In modern science, researchers use different terms to describe the ability of an individual to maintain the adequacy of the mental state and the effectiveness of activities in extreme conditions: stability of personality (L.I. Bozhovic), mental stability (A.M. Stolyarenko), emotional stability (L.M. Abolin), moral-psychological stability (N.F. Fedenko).

The relevance of our article is determined by the requirements of professional activity of engineers at the stage of mastering the profession, which is characterized by increased stress. And for this, first of all, it is necessary to study what types of response and coping strategies exist among students-future specialists in the field of energy in stressful situations

To study the characteristics of stress resistance of students - future engineers we used the following psychodiagnostic methods: scale PSM25 Lemur-Tessier-Fillion in adaptation by N.E. Vodop'yanova is designed to measure the phenomenological structure of the experience of stress. The purpose-measurement of stress in somatic, behavioral and emotional indicators and the technique of "Coping behavior in stressful situations" (adapted version of T. A. Kryukova) [1]. This questionnaire includes a list of specified responses to stressful situations and is aimed at determining the dominant coping - stressful behavioral strategies.

The experiment was conducted on the basis of the Institute of Nuclear Energy and Industry of Sevastopol State University. The experiment involved 40 second-year students in the engineering field of training.

A fundamental element of our empirical research was the scale of psychological stress, which is designed to measure the phenomenological structure of stress experiences. Questionnaire "scale of psychological stress" is aimed at measuring the stress at the following levels: somatic, behavioral and emotional. The higher is the index of mental tension, the higher is the level of psychological stress [2].

The average rate of mental tension in the sample is 78.2, indicating a state of psychological adaptability to workloads. Consider the level of mental tension in students of various training areas in the field of energy (Fig.1). Figure 1 – Average indicators of mental tension in students in the field of energy



As can be seen in Fig.1 level of mental distress in students – future engineers in the field of energy is low, below 100 points. It shows the adaptive state of the respondents to the workers, in this case, learning loads. The index of mental tension rises slightly in students in the field of nuclear power to 94.3 points, thereby increasing the level of stress in these students.

Thus, students studying in the field of energy have a low level of stress feelings and, accordingly, a low level of stress, which shows an excellent level of psychological adaptation to stress.

To study the features of coping behavior, we chose the technique of "Coping behavior in stressful situations", an adapted version of T.A. Kryukova. Coping behavior is defined in psychological literature as the behavior that allows the subject to cope with stress or difficult life situation by means of conscious actions in ways adequate to personal characteristics and situation [1].

Следовательно, в процессе высшего технического образования, у студента должна быть сформирована данная компетенция. As part of students training in the field of energy, there are so-called competence, which should be formed in the learning process. One of them is a general cultural competence of the general educational program – to find organizational and administrative decisions in unusual situations and readiness to bear responsibility for them. Therefore, in the process of higher technical education, the student must have this competence.

In fact, it is the development of so – called coping behavior, from a psychological point of view as conscious behavior, aimed at active interaction with the situation-changing the situation (verifiable) or adaptation to it (if the situation is not verifiable). In this case, it is non - standard situations associated with both the person and the system "Man-Technology". If the subject does not own this type of behavior, there may be adverse consequences for its productivity, health, well-being and reliability of the system as a whole. The average figures for the study of coping behavior are presented in Fig. 2.

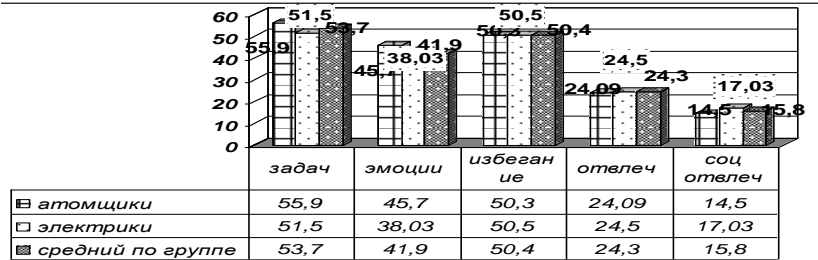


Figure.2. Average results according to “Coping behavior in stressful situations” method

According to the author of the methodology, the coping strategy, which scored the highest number of points and is dominant, the maximum number of points is 75, except coping strategies: distraction (the maximum number of points – 40) and social distraction (25 points). As one can see in figure 2 interesting features of coping behavior of students – future engineers were received.

Such dominant coping strategies focused on problem solving (55,9), avoidance (50,3) and emotions (45,7), as well as social distraction (14,5) were revealed in atomic department students.

To choose the most coping strategies have electricians: coping strategy-oriented decision problems (51,5), avoidance (50,5) and emotions (38,3), and social diversion (of 17.03).

Thus, students-future engineers of energy department are dominated by the following coping strategies, which they use in stressful situations: problem solving, avoidance, social distraction and distraction. A low high stress resistance indicator shows that students are able to choose the most effective coping strategies that will help them in their future professional activities.

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**Аннотация.** В работе рассмотрена проблема стрессоустойчивости у студентов – будущих специалистов в области энергетики. Представлено эмпирическое исследование уровня стрессоустойчивости и доминирующих копинг-стратегий. Данное исследование помогает понять особенности подготовки инженеров и спрогнозировать успешность профессиональной деятельности.

**Ключевые слова.** Стресс, стрессоустойчивость, копинг-стратегии, студенты - инженеры в области энергетики.

**Summary.** The paper deals with the problem of stress resistance in students – future specialists in the field of energy. An empirical study of the level of stress resistance and dominant coping strategies is presented. This study helps to understand the peculiarities of training engineers and predict the success of professional activity.

**Keywords.** Stress, stress resistance, irrational installations, coping strategies, students-engineers in the field of energy.

## **PRENATAL STRESS AS A RISK FACTOR FOR DEVELOPMENT OF SCHIZOPHRENIA**

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Recently, scientists are actively studying prenatal stress as a risk factor for schizophrenia. There is a modern theory that the predisposition to schizophrenia can be from birth, the so-called "model of stress-diatheisis". Many psychoanalysts believe that prenatal stress can play a pathogenic role in the emergence of schizophrenia. However, the study of these aspects showed that the disease is mainly based on the medical history of patients.

It was proved that in the "mother — child" dyad the traumatic connections can be formed, which further lead to pathological changes of the personality. From Biology lessons it is known that the mother acts for the child as important information in the period when the child absorbs her milk. Scientific fact proves once again that more than 50% of women during pregnancy experience psycho-emotional stress [1].

It was considered the case of a woman who had no congenital diseases and did not get sick, but after divorce, carrying a fetus, she experienced severe stress due to the negative situation of divorce. She had two children, but the second child (after the divorce) was very different from the first child. After a certain period of time, the psychiatrist diagnosed "schizophrenia» [2].

Since our body includes the protective mechanisms of the psyche in the case of emotional stressors, it can be assumed that the emotional stress that the woman suffered with the child, can cause some shifts in metabolic processes and activate others related to the regulation of the immune system and the mother and fetus. However, we cannot assume that this is the only factor that can cause the development of schizophrenia.

In most clinics there is psychological prenatal care. It is aimed at providing psychological support to pregnant women, as well as to improve their physical and psycho-emotional state. We believe that this is an important condition for the prevention of negative conditions of childbirth, including one of schizophrenia.



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**Аннотация.** В данной статье рассматривается феномен пренатального стресса у беременных женщин, а также факторы риска развития различными психическими заболеваниями, и особенно шизофренией.

**Ключевые слова.** пренатальный стресс, генетика, инфекция, психологическая травма.

**Summary.** This article examines the phenomenon of prenatal stress in pregnant women, as well as the risk factors for development of various mental illnesses, and especially schizophrenia.

**Key words.** Stress, genetics, infection, psychological trauma.

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## FEATURES OF PROFESSIONAL TRAINING OF JUDGES

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The main psychological problem of studying the relationship between man and the profession is their correlation. University training, mastering the knowledge and skills necessary for future professional activity contribute to the awareness of their professional maturation, the formation of students ' professional reflection, which is the main, part of the professional self-determination of students and is still in the area of immediate development.

The result of professional preparation leads to professional competence, a substantial element and condition for the development of one is reflection (V.A. Mamaeva). Personal reflection promoting reflection, the subject of inner world and the diversity of own individual characteristics (N. I. Gutkina, M.Y. Dvoeglazova, etc.), is the basis for professional reflection (A.A. Bizyaeva, T.V. Yurova) in the future is the development of professional competence of future specialists.

In the process of professionalisation, according to Y. Povarenkov [4], the subject of work implements three main forms of activity: operation

(implementation), creation (change) and self-control. The first form provides the realization of the available resources of the subject of labor, in terms of changing the subject of labor, the second-changing and improving the resource capabilities of the subject, and the third form – sensitization and correction of the first and second forms of activity. Simplifying the situation, it can be argued that the subject realizes one of the three forms of professional activity mentioned above at any given time.

The role of professionally important qualities are professional abilities (professional talent), professional knowledge and skills (professional experience), professional motives (professional orientation), professionally oriented personality and individual qualities. The system of professionally important qualities provides a certain level of professional competence of the labor subject [4].

In the process of professional formation and implementation, the subject of labor carries out well-known activities: search and choice of profession, educational and labor, educational and professional activities, professional adaptation and self-determination, etc. [4].

Participating in professional activities, the individual gets acquainted with the profession, finds out his own opportunities and actively develops them. Being formed as a subject of professional activity, he/she develops as a person. The main task is to prepare for an independent and informed professional self-determination, i.e. the ability to plan the future taking into account their interests, capabilities, needs of society.

The main essence of the problem of formation of professional personality is in two basic provisions [1, p. 10]:

1) "personality manifests itself in the profession" - in the process of choosing and mastering the profession, professional development and implementation of the professional personality, determining its place in society, achieving material and spiritual values, satisfaction of personal cognitive interests;

2) "development of the person in activity" - formation of professionally oriented qualities of the person (his organism and personal traits), expansion of the sphere of knowledge of the world and its semantic content, development of forms and content of the subject of communication.

The problem of formation of professional personality is complex, and it is possible to distinguish and consider psychological, professional, physiological, medical, social and other aspects.

Thus, the formation of a professional personality in the process of mastering labor activity is not reduced to the development of its operational sphere in the form of accumulation of knowledge, skills and abilities, but involves the formation of complex mental systems of regulation of its social

behavior, as evidenced by the results of L.S. Vygotsky's research [2], A.N. Leontev [3], S.L. Rubinshtein [5] and a number of other psychologists.

The peculiarity of these conditions is, first of all, that they reflect the specifics of the expert's work as an activity related to the administration of socialist justice.

These include [6]:

- strict legal regulation of expert activity, combined with the independence of the expert in the election of the types of research that should be conducted to address the issues raised by the body that appointed the examination;

- duty of keeping official secret;

- особая общественно-психологическая атмосфера расследования, при которой к результатам экспертизы проявляется интерес не только со стороны назначившего её органа, но и всех лиц, так или иначе заинтересованных в исходе данного уголовного или гражданского дела;

- outcome of the criminal or civil case;

- lack of time set for the examination and, as a consequence, the constant mental and emotional overload of the expert.

These features require the expert mental qualities such as Communist ideologies and principles, a highly developed sense of justice, an increased sense of responsibility. This, in turn, implies the presence of high-volitional qualities of a person engaged in expert activities.

The specific tasks performed by the expert examination in criminal and civil proceedings have an impact not only on the psychological qualities of the expert's personality, but also on the external conditions in which these qualities find their manifestation.

Thus, the variety of objects of expert research requires the expert in the conditions of scientific and technical revolution of systematic replenishment of special knowledge and mastery of new research techniques. Therefore, one of the prerequisites for successful work of experts is not only the availability of appropriate technical means in the expert institution (equipment, instruments, etc.), but also the systematic publication or acquisition of special and reference literature.

The success of professional activity is determined on the basis of two main criteria: objective, which characterizes the effectiveness of labor, and subjective, associated with the individual characteristics of professional self-determination of personality and professional reflection in general. Professionalism is accompanied by a change in the person as a whole-the development of his/her individual, personal, subjective qualities, the formation of individuality and self-awareness as a professional.

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**Аннотация.** В работе рассмотрена проблема профессиональной подготовки судеб. Представлен теоретический анализ понятия профессионального самоопределения и профессионального развития. Выведены психологические условия формирования специалиста в области судебной деятельности.

**Ключевые слова:** Судья, профессиональная подготовка, профессионального самоопределение, профессиональное развитие.

**Summary.** The paper deals with the problem of training of judges. Theoretical analysis of the concept of professional self-determination and professional development is presented. Psychological conditions of formation of the expert in the field of judicial activity are deduced.

**Keywords:** Judge, professional training, professional self-determination, professional development.

## SECTION 10: PHILOLOGY



UDC 81`42

### ON THE PROBLEM OF CONTENT OF THE CATEGORY OF TEXTUAL EMOTIVENESS

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The status of the category of textual emotiveness is not defined for today as well as verbalization means of emotions on textual level. Moreover, this problem is complicated by existence of a large number other similar terms such as emotive space, emotive textual level, and emotive background and so on. So, these terms are to be considered for defining of the category of textual emotiveness.

Shahovski V.I. highlight one another problem linked with distinction of “the emotive text” and text which is evocate an emotions because there are two types of representations of emotiveness in text: it can be explicit and implicit emotiveness [8].

That is why we must identify all formal markers of explicit type of textual emotiveness. Shahovski V.I. asserts that in can be lexical units, grammatical structures, prosody, and other phonetic aspects. The intensity

of emphasis of the category of textual emotiveness depends to density of these elements in text [7, p. 181].

Certainly, the most significant means for emotive explication are description of feelings and emotive behavior state of man or literary personage and other physical reactions. With regard to implicit realization of the category of textual emotiveness, we must admit that it's realization linked with the usage of allusions, quotation, parody, and intertextuality [3].

On the whole, Shahovski V.I., Ionova S.V. and followers of the Volgograd school of emotive linguistic are considering the category of textual emotiveness as semantic-functional category, it's realization provides external transfer of emotional state of language personality, but not an evocation [4; 9]. One of the most important characteristic of this term is the density of emotive units in text [8, p. 185].

In spite of simplicity defining of expressiveness (emotive intensity), the question of expressive effects is not resolved because the expressiveness is the result of usage pragmatic aspect of language.

As Filimonova O.E. assert, the category of emotiveness is mostly demonstrated in speech than in language, and more vividly in that in others [6, p. 76]. Furthermore, many scientists considered that only texts in belle-letter style could be an object of such analyses some time ago, but this is so from true now [5, p. 96].

In addition, Filimonova O.E. suggests that the textual emotiveness is the category which reflects real or imaginary situation where subject experience some feelings [5, p. 3]. Also we must pay attention on specific this category realization and its intensity because it usually depends on functional style and make up another serious problem in linguistics [4, p. 5].

Obviously, each type of text is characterized by some peculiarities, patterns, and established rules. We can ensure if we try to compare official, scientific, and belle-letter style. And the main feature of belle-letter style, for example, is that the textual emotiveness is reflects in contextual emotive units.

There is another one category which helps us in textual analyses that was formulated by Shahovski V.I., and this is "emotional coloring". The term "emotional coloring" is interpreted in a broad sense as a spectrum of linguistic and textual composition means which an author uses when he is coding the emotional aspect of informational content of some text [9, p. 22].

We must admit that this term has many in common with our main category and mostly similar but as Shahovski V.I. asserts the "emotional coloring" is the only part of the category of textual emotiveness and is related exclusively to linguistic means of emotive expression.

It should be recalled that Ionova S.V. formulated the term "emotive

tonality”. The category reflects on communicative level of text as conceptual information and is functioning as author’s pragmatic strategy [4, p.12].

Two scientists (Nashoeva M.R. and Ionova S.V.) use terminology of cognitive approach in linguistics. According to those point of view emotive states is classified as the method of reflection and as an object of reflection. Therefore, we can distinguish two sides of the category of textual emotiveness: “emotive tonality of text” and “emotive background” [5, p.97; 4].

According to Babenko L.G. and Kazarin Yu.V. points of view the textual emotiveness includes “an emotive space” and “emotive senses” [1]. The notion “sense” means an elementary part of text which reflects objects of ideal and material world and “emotive senses” can be word with semantic refiner, phrases, abstracts, or even whole text. [1 p. 122]

In conclusion, we can say that the definitions of prevail number of terms are ambiguous and amorphous, and many of them duplicate each other. the intensity of textual emotiveness is expressed in pragmatic level and their rate and density of emotive units in text. Undoubtedly, emotive units mustn’t be considered without context because contextual semantic discloses new limits of sense, convey unknown shades of emotion. The emotions usually do not express separately, and so make pragmatic richer.

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**Аннотация.** Данное исследование посвящено рассмотрению категории текстовой эмотивности и проблем связанных с содержанием данной категории. Автор анализирует различные подходы к исследуемой категории, которые закрепились в отечественной филологической науке. Поднимается вопрос о смежных терминах и их соотношении, используемых в научной литературе, таких как эмотивный фон, эмотивный уровень текста, эмотивная окраска и других. Автор приходит к выводу о том, что данная категория представляет собой совокупность использованных в тексте эмотивов, то есть лингвистических средств передающих или описывающих эмоциональное состояние говорящего.

**Ключевые слова:** текст, текстовая эмотивность, категория эмотивности, эмоция, лингвистическая концепция эмотивности.

**Summary.** This paper is devoted to considering the category of textual emotiveness and a number of problems connected with its content. The author gives an overview of approaches to this question in contemporary philology and trying to give an analyses of different elements that this concept consists of. The author is taking up the question about correlation of variety of terms such as emotive background, emotive textual level, emotive coloration and some others. The author made the conclusion that the category of textual emotiveness is the complex of linguistic means which are able to convey of describe different features of emotional state of speaker.

**Key words:** text, textual emotiveness, category of emotiveness, emotion, the concept of emotiveness.

UDC 811.111

## **COMMUNICATIVE STRATEGIES OF INFLUENCE IN ENGLISH ADVERTISING SLOGANS OF PERFUME BRANDS**

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*Introduction.* Linguists are more frequent turning to the advertising theme, because it is one of the most vivid means for reflecting human



communication in today's society, which is increasingly affected by the great influence of mass communication. Scientists pay attention to the technology that can convince consumers to buy new products. But advertising is a historical phenomenon and very quickly becoming obsolete. Impact technologies are also changing, introducing new means of persuasion. Therefore, now advertising requires further studying the innovative means of influencing mass consciousness, extra-linguistic and linguistic.

In the advertising text the language compression and the linguistic factor of influence on the addressee are especially highlighted. There is a lot of research on advertising text devoted to the analysis of its structural, semantic, genre and communicative peculiarities (S.V. Gusenko, O. I. Zelinskaya, Kh. Kaftanjiev, L. A. Kochetova, Yu. B. Pukuleva, Ye. A. Selivanova, K.V. Shido, etc.), stylistic and semiotic characteristics (N. L. Kovalenko, Ye.Ye.Tkachuk-Miroshnichenko, etc.), studying the pragmatics of advertising text (A. A. Vornachev, T. V. Gulak, O. V. Dmitruk, V. V. Zirka, M. L. Kramarenko, N. S. Lissa, etc.). At the same time, there are no systematic studies of the English advertising text, the problems of subordination of the lexical-semantic, structural-grammatical, functional-stylistic characteristics of the advertising slogan, including the English slogans, to its communicative-pragmatic purpose remain in the context of the communicative-functional orientation of contemporary linguistics, acquires special significance. The above-mentioned arguments determine the relevance of the advertising slogans studying, because of the slogan is a nuclear component of the advertising, it must give true information about the subject of advertising to mass audience for encouraging people to take advantage and buy the advertised product/service, that must transmit a pragmatic setting to convey accurate information about the subject of advertising to the greatest number of people for encouraging them to buy the advertised product/service [4, p.16]. Eg.: *Chanel Chance. Eau Tendre. This is your chance. Do not miss it!* Linguistic problems, connected with the realization of communicative strategies of influence in English advertising perfume brands slogans, have not yet been the subject of a special research.

*The research goal* is to reveal the specific implementation of communicative impact strategies in English perfume brands advertising slogans.

*The actual research material* consists of 500 English perfume brands commercial advertising slogans.

**A main part.** An advertising text is a unit of a communicative act, the communicative event. It has a communicative focus (target setting), the

importance, the communicative structure, which follows from the communicative purpose (intention, motive, meaning, tents/intention), includes communicative strategies and tactics. Communicative strategy is «to deploy a thesis (main idea), which is not only possible to reveal the content, but also to affect the situation» [5, p. 106]. A choice of a general compositional type, methods of setting facts, a facts coverage, general tonal of the work are associated with the communicative orientation of the text. As K. Serazhim notes: «Communicative strategy is determined by a target and is reflected in the plan or in the abstracts of the prepared speech works» [11, p. 106].

One typology of communicative strategies has not yet been established. So, T. A. van Dijk, depending on discourses, identifies the following strategies: cognitive, contextual, understanding, speech, semantic, syntactic, schematic, text, etc. [1, p. 264].

The nature and method of communicative influence the consciousness are not precisely defined. Scientists understand them in different ways:

a) the impact on the consciousness by establishing rational argument (persuasion);

b) the impact on the consciousness through the emotional sphere;

c) the impact on the subconscious (suggestion);

d) the impact with the verbal (speech impact) and non-verbal means.

For the communicative impact purposes the speaker uses certain strategies, which are the constitutive signs of any type of discourse. Yu. K. Pirogova considers the communicative impact strategies in advertising discourse, as the techniques of selecting, structuring and presenting information about the advertised object. These techniques are subjected to the goals of communicative impact, which is the best to represent this object on the market [8, p. 210]. The main goal of communicative strategies is to distinguish the object from other competitive objects and to focus (or even artificially construct) its attractive properties (real and/or symbolic) for the recipient.

Yu. K. Pirogova offers to distinguish the strategic (above-mentioned) goal and the additional communicative goals, without achieving which in the advertising discourse it is difficult to realize the main goal. Additional goals are associated with overcoming unfavorable conditions of communication, which are determined by the peculiarities of perception such information and the relation to it. Thus, it is known that advertising is perceived, interpreted and evaluated other than non-advertised information. Advertisers need to overcome inattention to advertising, lack of interest in it, prejudice and distrust of the addressee. Among the unfavorable factors of the channel of communication Yu. K. Pirogova calls «the lack of direct

contact between communicants, the impact on the addressee of competing advertising messages and other information flows, which provoking cognitive dissonance» [8, p. 211].

Thus, according to the above-mentioned opposition, Yu.K. Pirogova distinguishes two types of communicative strategies in advertising discourse: a) positional strategies aimed at forming the planned perception an object that is advertised; b) optimization strategies aimed at optimizing the impact of the actual advertising message. To create an effective advertising message, it is usually necessary to use both types of strategies. They can be combined even in one advertising phrase or one visual image. Communicative strategies are directed to make an advertising impact on the addressee [8, p. 211].

As N. S. Lisa points out, the concept of “advertising impact” reflects the moment (process) of penetration into the recipient’s consciousness the advertising information, the formation his beliefs, desires, attitudes towards purposeful action in the general system of communicator’s activity. This is possible only with the successful passage of advertising information through the psychological filters of the recipient. As a result, a motive may arise, strong enough to induce the recipient to act. Then the chain of advertising impact is closed, thereby ensuring the effectiveness of advertising [6, p. 164-184].

The advertising message content is determined by many factors, among which the goals and the nature of the impact on the addressee play the main role. The advertising impact on the recipient is designed to create a social and psychological setting for him. An attitude is the internal psychological readiness of a person for any action [5, p. 16]. In general, it can be argued that advertising is not simply information, it is also the psychological programming of people. Already from this point of view, we can distinguish such basic levels of psychological impact of advertising [9]: cognitive (information transmission, communication); affective (emotional aspect, relationship formation); suggestive (suggestion); conative (establishing behavior).

The essence of cognitive impact is the transfer of a certain amount of information, a set of data on the product; factors that characterize its quality, etc. The cognitive component of the advertising impact is related to the ways, how advertising information is perceived, understood and assimilated by a person. The study of the cognitive component involves the analysis of information processing, such as sensation and perception, memory, imagination, thinking, speech, etc. Advertising products can be heterogeneous in quality - and this will have different effects on the cognitive sphere of a person. As a result, the advertising message will be

perceived ambiguously and remembered by individuals, create a different degree of readiness for action. As one of the main objectives of the advertising impact is precisely in the allocation of the advertised product or service, attracting the consumer's attention to it, researching the cognitive processes of the psyche is very actual in the framework of advertising activities.

The goal of affective action is the transformation of an array of transmitted information into a system of attitudes, motives and principles of the message recipient. Tools for forming relationships are frequent repetition of the same arguments, bringing the logical proof, the formation of favorable associations, etc. The goal of affective action is the transformation of an array of transmitted information into a system of attitudes, motives and principles of the message recipient. Tools for forming relationships are frequent repetition of the same arguments, bringing the logical proof, the formation of favorable associations, etc. The affective (emotional) component of the advertising impact determines the emotional attitude to the object of advertising information: does the subject refer to it with sympathy, antipathy, neutrally or contradictorily. Research of the psychological aspects of advertising activity involves an analysis of such its aspects that cause a person to have an emotional attitude toward advertising, to the product itself, which forms as a result a desire or unwillingness to buy it.

Emotions are such a mental processes in which a man directly and personally experiences his attitude to various phenomena of the surrounding reality or in which different states of the human body get their subjective reflection. In psychology, it is believed that numerous human emotions can be described by several basic components: love, joy, happiness, surprise, sadness, suffering, fear, anger, rage, disgust, contempt, guilt, etc. They are expressed in a variety of individual characteristics. Thus, the immediate experience of phenomena and situations acting on an individual is realized in various forms of emotional experiences that are postponed in emotional memory. The emotional impact is strongly influenced by the brightness of impressions.

Suggestion involves the using of both conscious psychological elements, and elements of the unconscious. The result of suggestion can be the conviction that it is received without logical proof. It should be noted that suggestion is possible, firstly, if it corresponds to the needs and interests of the addressee, and secondly, if a person with high authority and enjoying unconditional confidence can be used as a source of information. Suggestion will be more effective if the advertisement is oftentimes repeated [3, p. 14].

The conative influence of the message in “pushing” the recipient to action, in prompting, what he should do. Communicative strategies play a key role. They are considered as the central link of speech communication, using which he realizes his intentions in discourse. Some researchers reduce the strategy to the process of choosing linguistic means, as well as certain speech actions. From a cognitive point of view, strategy is considered as a global conception of the means to achieve the goal [2, p. 53]. It is obvious, if the goal is accessed by optimal means, then the strategy is used well. The advertising texts highlight questions, that have different illocutionary functions: question, that is the direct appeal to the consumer, it encourages him to join a socially more relevant target audience (*You are one of them? Givenchy. Gentlemen only; Are you on the list? Carolina Herrera 212 VIP*); question-temptation (*Do You Dare? Curious. Arpedge*); a philosophically coloured question that makes the addressee think about his status, his way of life; such a question appeals to the vanity and self-esteem of the communicant (*Who are you today? Mexx; Did you rock someone's world? KENNETH COLE RSVP*).

Questions can alternate with an indication of the recipient's speech actions, a commentary on his speech actions (*Do not be afraid to go in, it will be interesting. Agent Provocateur Maitresse*). In this case, there is a specific impact on the addressee's consciousness through linguistic expressions, which are organized according to the principles of persuasion adopted in the culture. In order to ease the pressure on the recipient, such words are used: *just, simply*. For example: *Just around you. Givenchy; Simply touch it! Britney Spears*. In some slogans, an «instruction» is provided that describes the actions of the addressee, for example: *If your friendly neighborhood grocer doesn't have a jar - knock something off a shelf. Guerlain; If you want to capture someone's attention, whisper. Coty Perfume*. The strategy of constructing speech action is based on the hypothesis of the situation and representations about the addressee of the text, involving such social, role, psychological, professional and other parameters, archetypes, stereotypes, certain realities inherent in a particular culture. For example, the image of France is always associated with love, fashion, beauty. It is stressed by copywriters in the advertising slogan: *Do you know the smell of Paris? Hilda Kozári Air; Very French Taste. Yves Saint Laurent. Rive Gauche*.

Basically the advertiser in his activity mainly strives to adhere to the axioms of responsibility, contact, interaction, relied, therefore, on moral values. The addressee is invited to act in accordance with the axiom of security, realism, sanity, relying on the values of the utilitarian plan. However, in the advertising of perfumes, which mainly appeals to the

recipient's emotions, we can see the opposite appeals to the addressee: *Be stupid. Diesel; Think less. Stupid more. Calvin Klein; Inspired by anarchy and chaos. Sex Pistols Etat Libre. d'Orange; Is this a scent of anarchy? Sex Pistols Etat Libre; Be unpredictable. Bleu de CHANEL; For the animal in you. Guerlain. Homme; Catch the fever. Beyonce. Heat.* Instead, advertisers use speech acts that imply the sentence (especially seductive in the advertising of perfume) to do something, for example: *Chase me ..., if you can. Maybelline. Protean charm; Catch me ...if you can! Chacharel.*

Communicative strategies are based on advice, recommendations for the target audience: *Be desirable. Be yourself. Blue Seduction; This is your chance. Do not miss it! Chanel Chance Eau Tendre; Life is beautiful. Live it your way.*

Depending on the direction of the action on certain cognitive mechanisms of the human psyche and, according to C. G. Jung's interpretation of consciousness as a psycho-functional continuum of five cognitive functions, Ye.Selivanova outlines the following types of strategies: suggestion strategies directed at the subconscious; mental, appealing to the mental field of the addressees; emotional, focused on the sphere of feelings and emotions; sensory - such that appeal to human feelings [10, p. 212]. Critical perception of the addressee is reduced. Advertising is an intrusive tool. It is constantly repeated, that strengthens its influence. Repetition of an advertising text fragments also affects the subconscious.

A text reduction is also the suggestion strategy, which is expressed in a certain simplification of the advertising text syntax (*Oh, this Baby Doll! Yves Saint Laurent; 100% Yes!!! Yes!!! Yes!!! Clairol; WOW! Pond's*), nominative one-part sentences (*Desirable. Misty. Miracle. Miracle Forever. Lancôme; Infusion. Prada; Twist. Glide. Shine. Revlon; Cold ocean. Armand Basi; Heart notes. Anna Sui; Men's power. ESTEE LAUDER; Moments of emotion. Guerlain L'instant Magique; Little Paris. Guerlain. La petite robe noire model; New Woman, New Chanel N°5. Chanel N°5 Eau Premiere*).

The oversaturation of advertising discourse with imperative mood verbs with the meaning of feelings or concrete actions directs the addressees to their own inner world, focusing attention in the right direction. It can also be considered as a variant of suggestion, which is qualified by experts in the field of neurolinguistic programming as a state of downtime - the direction of the person inward, mediated by the formation of a feedback loop with internal analogies [7, p. 147]: *Feed your inner rebel. Sex Pistols Etat Libre d'Orange; Share the fantasy. CHANEL; Remains only calmness. Hugo Boss; Scent of desires. Shalimar Parfum Initial. Guerlain.*

In advertising perfume mental strategies are practically not used, because of perfume products are associated with the emotional sphere of human being.

Sensuality, the predominance of the emotional over the rational, the aesthetization of the object that is advertised, the consumer, who uses the product, his behavior, that is embodied in the advertising perfume slogans, predetermining the usage of emotional strategies that give greater expressiveness and expressiveness for advertising slogans. Ex: *Moments of emotion. Guerlain. L'instant Magique; Moving to your heart. Chanel Allure; Hot touch. Moschino; Passion Elixir. Amor Amor by Cacharel. Perfume For Femme Fatale COCO by CHANEL.*

In fact, emotional strategies in advertising are hedonistic. They are aimed at achieving pleasure, the dream of the consumer: *Let desire lead you. Lo Deseo; A desire, a sensation, a choice, an instinct. Gueerlain. Homme.*

Creative and emotional strategies have a high persuasive potential in advertising. They accentuate the recepiant's desire for a new, which is usually perceived positively: *A sassy new spin on pearls so lustrous. So luscious. Maybelline; A new breeze of romanticism flutters through Paris... Tresor Midnight Rose Lancome; A new emotion. Yvresse Eau de Toilette Legere Yves Saint Laurent; A new intensity of seduction. Elixir Midnight Poison Dior.*

The means of representing the sensory strategies in advertising discourse have a metaphoric nature: *Melody of your sensuality. Agent Provocateur; Highlights your natural magnetism. Agent Provocateur; A sensual new chapter. Miss Dior. Le Parfum.*

In modern advertising, certain manipulative strategies, in particular language ones, are used to influence the consumer. Almost all involved in the advertising manipulation process. Advertising slogans are cited more often than the statements of famous writers and poets, giving us not always the necessary information.

Times change, and due to successfully created texts, advertising changes. For example, instead of magic words - *number 1, new, super. cheap*, which still form the basis of the advertising effect, more elegant and attractive formulas come: *The perfume of mystery. Guerlain. Mitsouko; The poetry of a winter fragrance. Givenchy .Very irresistible; The height of masculine sophistication. Dior Eau Sauvage, etc.*

There is no doubt that the basis of linguistic manipulation is the metacommunicative instructions of the advertiser (copywriter), which help to transform the world in accordance with these directions and create as a result an advertising myth. For example: *The mystery of Dior's legend.*

*Hypnotic poison. Dior; The royal luxury. Intense Tiare Montale; Feel like a queen. Cristina Aguilera. Royal Desire; The Scent Of A Woman. Chanel N°5; The Style makes the man. Chanel Allure Homme.* The myth gives the status to the brand and a sense of its own importance to the consumer: *Some perfumes are born a myth. Dior.*

The identification of the optimal language determination of both social and individual behavior of people is the main goal of the advertising message addresser: *Create your word of happiness. Especially Escada; Leave a trace. Porsche Sport; Promise her anything, but give her Arpege. Arpege.*

It should be noted that advertising of the 21st century has become more adept and exquisite due to the ability of copywriters to formulate correctly explicit content and to conceal implicit meaning in it, which forces the consumer to take the appropriate solution (that the advertiser needs).

*Conclusions.* All levels of psychological influence (cognitive, affective, suggestive and conative) are presented in the advertising discourse, thus creating a social and psychological attitude. However, the conative level is particularly prominent, because communicative strategies help to force the addressee to perform the desired action play a major role in it. Manipulative impact strategies are of particular importance. Emotional and sensory communication strategies are the most common in the advertising perfume slogans.

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**Аннотация.** В статье рассматриваются коммуникативные стратегии влияния в англоязычных рекламных слоганах парфюмерных брендов. Выявлена специфика реализации различных типов коммуникативных стратегий на когнитивном, аффективном, суггестивном и конативном уровнях воздействия парфюмерной рекламы. Описаны эмотивный и апеллативный факторы влияния на адресата. Охарактеризованы особенности манипулятивной игры в рекламе.

**Ключевые слова:** реклама, рекламный слоган, коммуникативные стратегии влияния, парфюмерные бренды.

**Summary.** The article deals with communicative strategies of influence in English advertising slogans of perfume brands. Specificity of realization of the various communicative strategies on cognitive, affective, suggestive and conative levels of perfumery advertising influence has been revealed. Emotional and appellative factors of influence on the addressee have been described. The peculiarities of the advertising manipulative game have been characterized.

**Keywords:** advertising, advertising slogan, communicative strategies of influence, perfume brands.

## IDIOMS IN BRITISH AND AMERICAN LANGUAGES

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English idioms are an important part of everyday English. They come up all the time in both written and spoken English. A number of studies consider idioms as one subcategory of the more general lexical phenomenon of formulaic language (Nattinger & DeCarrico, 1992; Moon, 1998; Wray, 2002; Wray & Perkins, 2000). Researchers such as Fernando (1996), Wray (1999), and Schmitt (2000) equate mastery of idioms with successful language learning and native speaker fluency – a perception that many language learners share. It often translates into a desire to acquire as many idioms as possible [3]. “No translator or language teacher can afford to ignore idioms or idiomaticity if a natural use of the target language is an aim” [1, p. 234]. McCarthy (1998), commenting on this phenomenon, observes that speakers use idioms creatively “by a process of ‘unpacking’ them into their literal elements and exploiting these” [2, p. 137].

The **Aims** of our research work are:

- to find and match Russian equivalents to the given idioms;
- to express the meaning of some idioms through definitions.

The **task** of my research work is to investigate idioms that are often found in British and American languages.

**Methods** of our research work are:

- 1) Searching for idioms (in various literary sources)
- 2) Systematizing idioms by themes (about 200 idioms of 13 themes have been studied)
- 3) Comparison with the native language by selecting the Russian equivalents to the English idioms
- 4) Determination of definitions
- 5) Practical usage of idioms in dialogues, stories, compositions, projects, debates, correspondence.

The result of the study will be:

- development speaking skills with the help of idioms;
- development skills in reading, writing, understanding, cultural communication.

Idiom (from the Greek “idioma” – peculiarity, originality) is the stable expression. Their meaning differs from the literal one of its components. Idioms have a wide variety of structures and combinations, mostly immutable and often illogical and may not obey the basic rules of grammar. Analyzing them it is possible to retrace the history of the country, partially to get acquainted with its customs and traditions, to get the concept of the mentality of people speaking the language.

“Two important methodological advantages ensue when a corpus can be consulted for examples of idiom usage. First, the idioms can be presented in authentic contexts rather than in the contrived ones often found in textbooks or thought up by teachers. A second and closely related methodological benefit of using a corpus is that idioms can then be taught from a discourse perspective rather than as isolated lexical items, with attention not only to their immediate context but also to their sociopragmatic and interactional features’ [3, p. 438].

At English lessons we got interested in idioms, as these turns of speech make our everyday speech beautiful and bright. An idiomatic expression is a phrase which meaning is difficult and sometimes impossible to guess by examining ones of the individual words it consists of.

Many new inventions and discoveries are made in the scientific sphere. The same happens with our speech. It develops and forms with the help of new words and expressions. At the same time some words disappear from our everyday life and are forgotten. If all the words in our language had clear and concrete sense our speech would be boring and insipid.

We got interested in this theme because of studying idioms of other languages. We’ll be able to communicate with people from other countries without problems. Idiomatic expressions are an important part of everyday speech and their knowledge is absolutely necessary when foreign language teaching, as they give expressiveness, imagery and often refined elegant brevity to speech.

Idioms are often used in everyday speech, people use them talking to each other. If you know idioms, you will not get in an embarrassing situation.

#### *The Volume of the Research Work.*

We have devoted the research work to the idioms which are often used in the British and American languages. We have analyzed idioms of different spheres of life: medicine and health; sports; food; parts of body; music; mature and weather; tourism; travelling; family; shopping and mass media.

The importance of the idiom is that they exist in any part of speech (literary, conversational, etc.), and they permeate and fill the whole

language. Idioms are the base of language, everyday creativity, which is involved in the majority of speakers of this language. Idioms are a great source for understanding and learning language. The use of idioms helps to improve their proficiency in the language. An important fact is that the idiom can appear in poetry, in the language of Shakespeare and the Bible. We can say that an idiom is a number of words which, taken together, mean something different from the individual ones of the idiom when they stand alone.

*Examples of idioms.* Though idioms are not translated word for word in our native language, we always try to find the right idiom to express their feelings, emotions, ideas, mood or desire.

We'll attempt to pick up idioms for the compilation of short stories, dialogues, essays and reports. So, on the theme "Health" and "Medicine", using such idioms, you can create an idiomatic dialogue (see table 1).

Table 1 – Idioms on the theme "Health" and "Medicine".

Idioms	Meaning
To be alive and kicking	to be well and healthy; to continue to be popular
To feel fit	feel cheerful and healthy
<b>To break out in cold sweat</b>	to begin to sweat from fear or anxiety
To be under the weather	feel unwell; be in accordance with the weather
To be a picture of health	to be the model of health
To fit as a fiddle	healthy, strong and physically fit
To be as right as rain	to be completely healthy
Hope against hope	hope for the best
To feel like a boiled wet rag	feel completely broken

On the topic of sport, you can create a dialog using such idioms as well (see table 2).

Table 2 – Idioms on the theme "Sport".

Idioms	Meaning
Be at one's best	to be in the best shape
Win hands down	easily win
(As) quick as flash (as lightning)	fast as lightning
Work miracles	do wonders
You never know what you can do till you try it	without taking up the case, you do not know what you are capable of

- Have you watched Winter Olympic Games?
- Sure, most of all I have enjoyed skating. Sven Kramer from Netherlands was *at one's best*. *He worked miracles*.
- I think that he *won hands down* because he *broke the rules*.
- You are wrong! Sven *set a world record* and *holds it* for many years because he is *as quick as lightning*.

- Would you like to try skating?
- It is not for me.
- *You never know what you can do till you try it!*

Sports idioms generally originate from a specific sport such as baseball or sailing. Over time these phrases have come to mean something that can be used in everyday life. “While most sports idioms can still be used when discussing sports, they are even more common in other areas of life, especially the business world” [4, www]. Here are a number of idioms, which are used in sports (see table 3).

Table 3 – Idioms, which are used in sports.

Idioms	Meaning
<i>Baseball</i>	
Have two strikes against one	you only have one chance remaining
Keep your eye on the ball	be ready
Take a rain check	accept at a later time
Go to bat for someone	defend someone
Throw someone a curve	surprise someone with an unexpected ac
Touch base	communicate
On the ball	ready and able
Out in left field	strange, very unconventional; completely wrong
<i>Swimming</i>	
Swim against the tide/current	swim against the flow
Make a splash	cause a sensation
Go off the deep end	not knowing the ford, don't go into the water
Keep one's head above water	try not to fall behind in work or other duties
<i>Boxing</i>	
Beat someone to the punch	determine
Hit someone below the belt	do or say something that is very unfair or cruel
<i>Horse racing</i>	
Down to the wire	right at the end
Get a head start	start before all others
Give one a run for one's money	try one's hardest to defeat another person
Neck and neck	to be in a close tie with someone
<i>Billiards</i>	
Behind the eight ball	be in a difficult and unfavorable situation
Call the shots	make the decisions
<i>Tennis</i>	
The ball's in your court	it's your decision or responsibility to do

	something now
Get into the full swing	be comfortable doing something after some time
<i>Hunting</i>	
Bark up the wrong tree	you've got the wrong person or idea
Give it your best shot	try your hardest
Long shot	a very difficult thing to accomplish

Here are some idioms on topic “Parts of Body” (see table 4).

Table 4 – Idioms on topic “Parts of Body”.

Idioms	Meaning
<b>ARM</b>	
To keep smb at arm's length	to keep at a respectful distance
To welcome smb with open arms	accept anyone with open arms
To be up in arms	be ready to pursue your goal
<b>BACK</b>	
To have no backbone	being a weak-willed person
To back a car	back up
To put one's back into smth	to work strongly
To take a backseat	to take a modest position
To turn one's back on/up on smth/smb	to turn away from someone; to break off relations with anyone
<b>BONE</b>	
A bone of contention	to be the cause of disagreement
To make no bones about	to speak openly and without hesitation
<b>BRAIN</b>	
To beat one's brain about smth	to puzzle over something
To have smth on the brain	get involved in something, get obsessed with something
A brain-wave	a brilliant idea suddenly came to mind
<b>BREAST</b>	
To get a clean breast of smth	pure heart to confess to anything
<b>CHEST</b>	
To get smth off one's chest	unburden
<b>BLOOD</b>	
A blood horse	thoroughbred horse
To make one's blood boil	bring someone into a rage
To turn in the blood	to be someone in the blood family
One's flesh and blood	relative

“Newspapers are most often published on a daily or weekly basis, and they usually focus on one particular geographic area where most of their readers live. Despite recent setbacks in circulation and profits, newspapers are still the most iconic outlet for news and other types of written journalism. To understand the language peculiarities of English newspaper

style it will be sufficient to analyze the following basic newspaper features: brief new items; advertisement and announcements; the headline; the editorial” [5, www].

The vocabulary used in newspaper writing is natural and common literary.

We’ve analyzed idioms in Mass media (see table 5).

Table 5 – Mass media idioms, weather ones

Idioms	Meaning
Mass media idioms	
Get a hold of someone	to contact with someone
Go around in circles	tangled
Go over with a bang	enjoy great success
To know ins and outs	know all the details
Be in the same boat	to be in the same position
To keep something under one’s hat	keep it a secret
The long and the short of it	in short
Once in a blue moon	rarely
Pull the wool over one’s eyes	mislead
Give someone the cold shoulder	cold to meet
Let sleeping dogs lie	not to stir the waters, while sleeping quietly
Play hard ball	to act aggressively
Turn a deaf ear	ignore
Idioms on "weather"	
To be windy	to be chatty
To be full of hot air	to be full of empty words
Under a cloud	under suspicion
Shoot the breeze	to talk; to make conversation
Take the wind out of smb’s sails	to put somebody to a standstill; to perplex anyone
Out of the blue meaning out of a clear blue sky	like a thunder in the clear sky
Clear the air	to eliminate misunderstanding
Dawn on someone	come to mind
Rain cats and dogs	very heavy rain
Get a second wind	second breath

Music is also frequently used in the English language. Here are some idioms on the themes music and family (see table 6).

Idioms	Meaning
Music idioms	
Sing the blues	miss
Play second fiddle to someone	to play a minor role

Play by ear	play by ear
Music to my ears	music for my ears
Change one's tune	rethink
Call the tune	dispose
March to a different drummer	in my mind
Tune out	disregard
All that jazz	living
Jazz something up	revive
Drum up business	finding customers/buyers
To be at the band	very strong; very fast
Face the music	responsible for their actions
Clear as a bell	clear; very simple
<i>Idioms on "Family"</i>	
A pet-model	darling
The baby of the family	youngest child
To be like two peas in a pod	similar as two drops of water
One's own flesh and blood	relative blood
Like father, like son	apple fall far from the tree
To carry marriage lightly	be undertaken lightly for family life
Water under the bridge	passed stage
Wear the pants in the family	be the master of the house
Give someone the shirt off one's back	to give the last
Head over heels in love	fall in love on ears
To keep one's nose to the grindstone	to work tirelessly
Lucky dog	lucky person
Look like the cat that swallowed the canary	to be happy
Turn over a new leaf	to start a new life

English idioms and their meaning(see table 7).

Table 7 – English idioms

Idioms	Meaning
Albatross around one's neck	stone on the neck
All hell to pay	a handful
Talk through one's hat	nonsense
Blow one's own horn	boast
Be down in the dumps	to be in a bad mood
The bone of contention	apple of discord
Bring down the house	evoke loud incessant applause
Rub the wrong way	to stroke against the grain; to irritate
Go over the top	start acting decisively



*English Idioms on "Food" and their definitions.*

Big cheese – very important person

Piece of cake – very easy

Hard nut to crack – difficult to understand

One smart cookie – a very intelligent person

Souped up – made more powerful

Hot potato – difficult subject

Bad egg – a person who is often in trouble

Cool as a cucumber – very relaxed

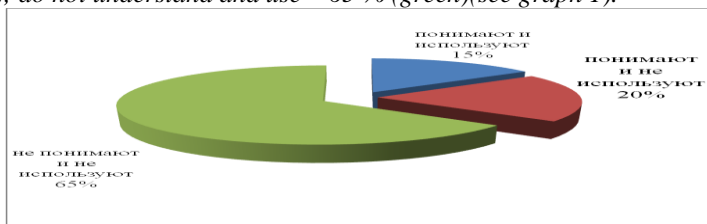
Extensive knowledge of idioms is the most important instrument of the interpreter. Knowing the language of the people, the interpreter must correct convey information to the language of another people. At the same time it is also important to convey the mood, profound meaning, emotions and so on. When the customer or the participants are satisfied with the translation, this is the success of an interpreter.

Having counted the number of idioms that are used in research we constructed a diagram: medicine and health – 8; sports –22; food –13; parts of body –28; music –15; nature and weather – 12; tourism –12; family – 19; shopping – 10; mass media – 16; interesting equivalents – 35. In general we've analyzed 211 idioms.

While working at this research we practiced questioning students. Most of the respondents are unfamiliar with idioms and use them in the speech rarely. Only a few respondents use idioms in their speech, know their meaning and how to use ones.

The final results have shown:

*understand and use – 15 % (blue); understand but do not use – 20 % (red); do not understand and use – 65 % (green)(see graph 1).*



Graph 1. The use of idioms

**Conclusion.** One of the main conclusions of the research work is as follows: idioms are used in our speech as a whole; they are not translated word for word. Idioms have a very delicate semantic stress. They are a product of folklore.

Our research has shown that:

– the use of idioms instills skills for reading, speaking, writing and cultural communication;

– idioms can improve communicative competences and pick up Russian equivalents to these idioms.

If you are interested in the studying of idioms, you should use a special dictionary of “Idiomatic expressions”.

Idioms serve for the direct exchange of ideas, in other words to communicate with the people. We use different idioms, ironically calls a friendly smile. So understanding between people of different nationalities is facilitated.

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**Аннотация.** В статье описаны основные категории идиом, представлены примеры идиом и их значения по наиболее распространенным темам. Проведено экспериментальное исследование для определения процентного соотношения употребления и понимания идиом в разговорной речи.

**Ключевые слова:** идиомы, английский язык, идиоматический, разговорный язык.

**Summary.** The article describes the main categories of idioms, presents examples of idioms and their meanings on the most common topics. An experimental study was conducted to determine the percentage of understanding and use of idioms in spoken speech..

**Keywords:** idiom, English idiomatic spoken language.

## MAIN FEATURES OF LINGUISTIC GLOBALIZATION

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In a global society, language problems are becoming global and require a global approach. This is manifested in the formation of languages of interethnic and international communication. The list of international words is actively expanding. There is a tendency of getting closer to the vocabulary content of different languages.

Due to role of cultural and economic connections between peoples, the increasing interaction of languages leads to the formation of a special fund of international words in both related and unrelated languages.

The issues related to the interpretation of the term "globalization" were considered by many scientists: I.A. Kardanova, N.N. Fedotova, N. Copland, N.S. Gureeva, G. Mayer, P. Shtompka, J. Mackman and others.

Theoretical understanding of integration aspects of culture in the process of learning a foreign language was researched by I.L. Bim, N.D. Holschova, E.M. Vereshchagin, V.G. Kostomarov, E.I. Passov, V.V. Safonova, V.P. Furmanova, S.G. Ter-Minasova, etc

Thus, I.M. Podzigun believes that globalization is an open, non-linear, difficult-evolving process of interaction between different subsystems of social unity – a developing society that has many levels and forms of manifestation [4]. The principle of dialogue allows to join various cultures, behaviors and activities and value orientations in the thinking and activities of people [5].

With the predominant role of cultural and economic relations between peoples, the increasing interaction of languages leads to the formation of international words foundation in both related and unrelated languages. Mainly such words belong to the field of special terminology of various branches of science and technology. It can be argued that mainly international vocabulary is present in the field of computer technology.

According to N.V. Padalka's view, globalization as a new stage of society internationalization is caused by innovative achievements of science and technology, new technologies and inventions [2]. The development of scientific thought and information technology in the communication system is based on the background of the widespread and foreign languages influence, first of all English.

Linguistic globalization occurs. The need for an international language in science, economics and technology is obvious. The ability of English to absorb the lexical peculiarities of other languages of the world is the main factor of its world domination.

E.N. Maluga understands linguistic globalization as the penetration of one language into another, which dominates over other languages of the world and affects their development. Thus American version of the English language transforms linguistic globalization into a universal system [1].

The purpose of this article is to consider the peculiarities of linguistic globalization, the tendency to converge the vocabulary of different languages in the conditions of modern development.

The globalization of the modern world and the clearness of socio-cultural boundaries have an impact on the cultural, linguistic and social identity of the societies of the world. The status characteristics of languages are subjected to significant changes. Intensification of social relations, which is a distinctive feature of the globalization process, requires a certain level of linguistic competence, knowledge of foreign language communication.

The language is not only a means of understanding the world; it also absorbs and refracts the entire body of knowledge, ideas about the world. "On the one hand, language is a product of culture itself and a means of its expression. On the other hand, it is a part of culture" [2, p.10].

A foreign language mastering is not just the acquisition of another psychological tool, but the enculturation to a different culture and mastery of the new socio-cultural content. Teaching a foreign language is considered as a dialogue of two cultures (the own and foreign language) in the general format of intercultural communication (cultural interaction of representatives of different linguocultures, taking into account their identity and originality) [5].

In the context of expanding socio-communicative processes, the status of foreign languages as a factor of stabilization becomes of particular importance. Today, English (American version) is the language of military, political and economic superpowers. This explains the terminology inflow given directions to other languages. One of the reasons for the emergence and development of the global English language is the world market formation as well.

In some cases, the formation of foreign words is inevitable. These words come in any language together with the previously absent realities, for which there is no designation in the language (for example, part of the terms of market economy). Such terms are:

*Marketing* is an organizational function and a set of processes of

creating, promoting, providing a product or service to customers and managing relationships with them with profit for the organization;

*Embargo* is a prohibition;

*Clearing* is non-cash payments between companies, enterprises and banks for goods sold and delivered to each other, securities and services rendered;

Royalty is a type of license fee, periodic compensation for the use of copyright, patents, franchises, natural resources and other property;

*Developer* is a specialist, conducting the development, promotion and further implementation of real estate;

*Franchise* is an object of the contract, a set of benefits, consisting of the rights to use the brand and the business model of the franchisor.

The modern law dictionary also contains words borrowed from other languages: *jurisprudence* (a science that studies the properties of state and law); *barrister* (a lawyer); *cession* (transfer or assignment by the creditor); *justice* (system of judicial institutions or judicial department); *guarantor* (state, legal entity or natural person giving the guarantee); *abrogation* (abolition of the outdated law because of its futility); *damnification* (loss, resentment); biocide (international crime against humanity).

Borrowed law terms solve the problem of understanding complex legal documents partly, simplifying the presentation of the text. Therefore, language borrowing is so important for jurisprudence.

The words "computer", "monitor", "radio", "TV", "supermarket", "Xerox", "football", "terror", "killer" and others can be called globalism. They are in all languages of the world.

Names of new realities in the linguistic form in which this reality was named for the first time are propagated (for example, there are types of physical education and sport, the names of which are included in all languages, even without translation: bodybuilding, diving, gymnastics, wrestling, bowling, skating, skateboarding, snowboarding, speed skiing, rafting, aqua bike, kite surfing, sky surfing, mountain bike etc.) These words are popular in all countries of the world in this lexical view, although they are used mainly by those involved in the relevant sports. According to the language status, these words and phrases are globalisms.

The international computer slang formation contributes to the linguistic processes globalization in modern society: *firewall* (software or hardware which helps to attack viruses); *software* (a computer program that implements the algorithm of actions); *hardware* (constructive part of the computer); *fake* (wrong); *to siphon* (to pump money); *vendor* (supplier or producer of goods and services); hacker (a person who commits various illegal actions).

In addition, in the age of globalization not only lexical units are borrowed, but also interjections, syntactic constructions. The professional differentiation of language increases. The special vocabulary exceeds common vocabulary and increases the social differentiation of the language. In general, there is a democratization of the language, the volume of borrowed words in communication is increased, but written communication is reduced.

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**Аннотация.** Цель данного исследования – характеристика лингвистической глобализации. Отмечено, что сегодня наблюдается тенденции к сближению словарного состава различных языков, а интернациональный словарный фонд значительно расширяется. Представлены примеры заимствований иностранных слов в сферах экономики, юридического дела, программирования.

**Ключевые слова:** глобализация, заимствования, лингвистическая глобализация, демократизация языка.

**Summary.** The features of globalization of linguistic processes in modern society are considered. The purpose of this study is to research the peculiarities of linguistic globalization. It is noted that there is a tendency to converge the vocabulary of different languages and the international

vocabulary fund is expanding significantly. The author represents some examples of borrowing of foreign words in the sphere of economics, law and programming.

**Keywords:** globalization, international words, borrowing of foreign words, linguistic globalization, democratization of language.

UDC 156.923.2

## **RELEVANT ISSUES OF PSYCHOLOGICAL ADJUSTMENT OF INTERNET ADDICTED ADOLESCENTS**

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In recent years there has been a rapid development of information and computer technologies that restructured substantially people's communicative and vital space. The emergence of a global information field causes a multitude of consequences affecting various spheres of life.

The new information environment, along with its positive influence, also introduces new hazards. Computer and Internet technologies have an impact on the human at all levels of his functioning, including individual, personal, operation levels and influence the formation of his individuality.

The invention of computer technology entailed the emergence of computer games, with the help of which a huge masses were involved in the game industry. Many of them have consequently acquired different addictive behavioral disorders.

Especially susceptible to the influence of computer gaming technologies are older adolescents who are in the middle of a process of transition from childhood to adulthood. This period embraces the main formations, such as self-consciousness, moral principles and a system of value orientations. Another element, associated with new vision for the future, called "self-concept" also begins to form. This life period is favorable for intensive socialization, social realization and the formation of an integral personal system—adolescents are interested in their personalities, identifying of their own capabilities and potential (according to A.A. Rean). This period of life is connected with a continuous, multilevel and intensive adaptation to different spheres of life.

Any emerging addiction, including a computer one, always has a bad influence on adolescents' adaptation to the constantly changing social and physiological conditions. And, of course, on the formation of their personality structure. According to the U. S. research data, the prevalence of Internet addiction among young people is about 2-8%. Following other data from K. Chakraborty and his collaborators' study, the prevalence of Internet addiction among young people ranges from 1 to 38% [4]. According to Korean researchers among seniors, 1.6% of pupils have an obvious Internet addiction, and approximately 38% of them have a possible one [3].

Analyzing the results of 3,500 inquiry tests, screening for Internet addiction (by K. Yang), V. Loskutova [2] has revealed that among all responders there were 74% of "healthy pupils", 24% of "on a border line" and 2% of "addicted". The analysis of the prevalence of Internet-addiction among Moscow adolescents, made by V.L. Malygin, A.S. Iskandirova et al., showed that 4.3% of them have signs of already formed Internet-addictive behavior, and 29.3% of the total sample abuse Internet resources and are at risk for problematic use of the Internet. An accurate data on the number of Internet addicted in Russia is not available.

Scientists explain such a large difference in the data for several reasons, including difficulties in conceptualization of Internet addiction, the lack of standard diagnostic criteria, the heterogeneity of population groups, lack of consideration of psychiatric co-morbidities in a number of studies.

Gambling rapidly spreads to become a particular case of Internet addiction.

There is no exact data on the number of online players, as such statistics are usually kept by the number of accounts created on the official server of the game. According to A.A. Denisov the number of users of online games in Russia is more than 8 million people.

In Psychology the study of Internet addiction began not so long ago. The theoretical and methodological basis of this study can be found in the works of K. Young, M. Orzak, M. Griffiths, J. Kendell, C. Chen, C.P. Korolenko, A. Egorov, V.L. Malygin, V.D. Mendelevich, B.D. Tsygankov. In Russian Psychology the concept of Internet addiction is based on the model of behavioural relationships extended by T.P. Korolenko, A.Y. Egorov, B.D. Tsygankov, V.L. Malygin [1].

The studies of V.L. Malygina, K.A. Feklisova, A.B. Iskandirova, A.A. Antonenko consider the approach of early detection of Internet addiction. Also a study of the individual psychological conditions of Internet users can be found in the works of O.N. Arestova, A.E. Voikunsky, S.O. Kpemeleva, O.V. Smyslovaya.



The scholars E. P. Belinskaya, John. Saller, S. Turkle, A. E. Zhichkina were engaged in studying of laws of construction of identity of the Internet user in the virtual environment. The analysis of personality changes that arise during Internet interaction is reflected in the studies of I. Goldberg, J. Grohol, V. Nesterov, J. Saler, K. Yang.

The studies related to psychological and clinical phenomenological features of online games' participants are conducted abroad. For example, R. Bartle has developed his own classification of players ("careerists", "researchers", "Internet-addicted", "assassins"). Based on this classification, J. Radoff has proposed the model of through-game motivation, under which the gamer's motivation can be competition, immersion, accomplishment or cooperation. Also literature provides some researches about social organization of a game world (J. Harris), the connection between player's role and experienced emotions (Sh. Turkle), psychological and emotional characteristics of online groups' leaders (N. Yi).

Russian literature delves into the problem of value orientations of online players (the works of A.A. Denislov), also the motivation for participating in online games (the work of S.I. Stepanova). The attempts are being made to determine any ways of correcting Internet addicted teenagers (e. x. works of Y.D. Baeva, S.K. Ryzhenko, A.V. Voikunsky, Y.M. Evstigneeva, E.O. Smirnova, V.S. Sobkin, A.G. Shmelev).

Despite the fact that the main attention of researches is directed to the negative impact of computer games, there is also a positive one. It is proved that computer games contribute the improvement of motor skills and concentration of attention and also promote the development of creative abilities in the process of solving game objectives (according to I.G. Belavina). Computer games are widely used to study mental processes. The obtained results allow us to evaluate computer games as a highly effective tool for the development of cognitive flexibility, creativity and other forms of critical thinking. The important part in the educational process is taken by computer games (V.G. Boltyanskii, E.P. Velikhov, V.V. Rubtsov, E.Y. Zaichkovsky, E.I. Mashbits).

For example, it is proved that fans of strategic computer games are distinguished by having skills of abstract modeling, possess a predominantly logical thinking, are able to focus their attention to numerous elements of a hidden playing field, have an advanced level of intuition.

Clarifying of the links of genre preferences and the players' personal characteristics can provide new opportunities of indirect observation of dispositional value-motivational structure of personality, which are difficult to identify through the direct method, using inquiry tests.

Thus, there are a number of works that reflect the positive effect of computer games. The study of E.E. Lysenko and O.K. Tikhomirov concluded that computer games could be considered as means of emotional discharge. Y.V. Fomicheva in her work describes the influence of games on the development of creative thinking, while O.K. Tikhomirova notes their positive influence on the formation of logic operations.

The main question is whether Internet addiction is a disease or a behavioural disorder. The specifics of this problem's interpretation depend on the researcher's view, while the conclusions depend upon the chosen method. At the same time, the actual existence of Internet addiction is confirmed by practice as there are definitely people exist with "problematic" behavior under using the Internet. One of the most important issues is the impact of the Internet on the individual's adaptation, that allows us to conclude that the importance of considering the "psyche and Internet" dyad is indisputable, especially during adolescence.

Adolescents are rapidly involved in all Internet-related activities. In respect that they still have unformed self-awareness and low regulatory capacity, adolescents become active Internet users. The main issue of Internet addiction in adolescence is its impact on adaptation. The Internet creates a basis for addressing teenagers' needs that can't be satisfied in the real life.

The Internet constitutes some means by which adolescents have the opportunity to express and assert themselves, to reduce their psycho-emotional tension, to increase the degree of independence and self-realization.

Teenagers get a wide selection of personal space and opportunity to exist within it. For such adolescents the Internet is an alternate reality for communication, interaction and exchanging information. It also provides an opportunity to create their own, privileged and safe space for communication. Information technologies give the opportunity to create a self-contained subculture field, containing the examples of socially-approved behavior or misbehavior. Thus information technologies affect the characteristics of the psychological adaptation of adolescents, which consists of the processes of socialization and individualization.

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**Аннотация.** Статья посвящена рассмотрению проблемы психологической адаптации Интернет-зависимых подростков в современных зарубежных и российских исследованиях. Были рассмотрены основные факторы и их признаки, влияющие на формирование компьютерной зависимости, а также положительное и отрицательное влияние компьютерных игр на развитие личности подростка. Интернет представляет собой некое средство, с помощью которого подростки имеют возможность выражать и самоутверждаться, снижать психоэмоциональное напряжение, повышать степень самостоятельности и самореализации. Информационное пространство становится источником коммуникативных и когнитивных потребностей, поиска возможных путей социально-психологической адаптации и компенсации индивидуальных трудностей.

**Ключевые слова:** компьютерные технологии, онлайн-игры, интернет-зависимость, наркомания, подростки.

**Summary.** The article is devoted to the consideration of the problem of psychological adaptation of Internet-addicted adolescents in modern foreign and Russian researches. The main factors and their signs, influencing formation of computer addiction, also positive and negative impact of computer games on development of the teenage's personality were raised. The Internet constitutes some means by which adolescents have the opportunity to express and assert themselves, to reduce their psycho-emotional tension, to increase the degree of independence and self-realization. The information space becomes a source of communicative and cognitive needs, a search of possible ways of social and psychological adaptation and indemnity of individual difficulties.

**Keywords:** computer technology, online games, Internet-addiction, addictions, adolescents.

## SECTION 11: RELIGIOUS STUDIES



UDC 246.3/241

### **ORTHODOX SAINTS IN THE SPIRITUAL AND MORAL DEVELOPMENT OF THE INDIVIDUAL**

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Today, educative activity among young people is particularly important. A high moral ideal is required for a healthy spiritual and physical development of the younger generation, a model that can be emulated. The life of saints nowadays is such an ideal of moral perfection [4].

The study of the role of saints in the spiritual and moral development of the individual in high school is a particularly urgent problem in the situation of social change, especially in Crimea. A distinctive feature of social changes in the framework of the regional aspect is the reassessment of values, change in social norms and crisis of social ideals [1].

“In the world of the XXI century Russia must be a sovereign and influential country in the context of economic, civilizational and military forces. We must not only develop confidently, but also preserve our national and spiritual identity and be a nation” [5, www].

Today Russian society experiences a clear shortage of spirituality – mercy, sympathy, compassion, support and mutual assistance as a deficit of those that always, at all times made people stronger historically.

“We must support the institutions that are preservers of traditional values, which have historically proven their ability to render them from generation to generation. The law can protect morality and should do so, but the law cannot establish morality. The state attempts to invade the sphere of beliefs and views of people are certainly a manifestation of totalitarianism. This is absolutely unacceptable to us. We are not going to follow this path.

We must act not by means of prohibitions and restrictions, and to secure a firm spiritual and moral foundation for our society. That is why the issues of general education, culture and youth policy are of crucial importance. These spheres are not a set of services but a space for the formation of a moral, harmonious person, a responsible citizen of Russia" [5, www].

Spirituality was considered N. Berdyaev, T.V. Kholostova, F.M. Dostoevsky, I.A. Ilyin, N.F. Faustova, A.F. Losev, L.N. Tolstoy, V.G. Fedotov, B.S. Bratus, A.I. Zelichenko, etc. Scientists S.S. Averintsev, D.S. Likhachev, Y. N. Davydova, A.Y. Gurevich described spirituality as a personal education with special valuable content that reflects the socially useful and necessary experience of spiritual creation. Many scientists consider morality within personality and activity approaches: L.S. Vygotsky, B.G. Ananiev, S.L. Rubinstein, A.N. Leontiev, D.B. Elkonin, L. . Bozhovich and others.

At the heart of the spiritual and moral development of the individual should be universal values in the frame of moral standards and new attitudes that have arisen at the present stage of development of society [2].

Thus, "spirituality is formed through the value-semantic reflection of the surrounding reality through the introduction to universal values, assimilation and creation of new spiritual values, through the active search of truth, goodness and beauty" [3, p.10]. Given the fact that today's young people see success and recognition as their main goal in life, it is very important to characterize Russian Orthodox saints as successful people and give examples of their actions and deeds that helped them to acquire mental and physical merits.

The purpose of this study is to determine the role of saints in the spiritual and moral development of the individual, since the ideal of spiritual and moral development of the individual expresses the humanistic system of values.

Examples of saints, Holiness, patriotism, valor and success have a huge impact on the spiritual and moral development of the individual. One of the striking examples is the Grand Duke Alexander Nevsky – a descendant of the family, who accepted Orthodoxy and contained a real Christian image. The authority of Monomakh (branch of the house of Rurik from Grand Duke (Velikiy Kniaz) of Kiev Vladimir Monomakh; the ruling dynasty in the Ancient state Kievan Principality) means "service to God", to his people. They began to form in Russia the idea of a United Orthodox state. They really combined the kindness and statesmanship.

The ways to achieve success and recognition are indicated in the quote from "Teachings of Vladimir Monomakh", written by Russian Prince Vladimir Vsevolodovich Monomakh in 1117:

"Do not forget good things and learn what you do not know – as my father, sitting at home, knew five languages, because of the honor of other countries. While creating goodness, don't be lazy, first of all in regard to the Church"[6, www]. The precept of Volodymyr Monomakh is not only an important literary monument, but also used by researchers as a historical source, which helps to get an idea about the moral values of the people. This is an example of kindness and humanity.

What was the immortal feat of Alexander Nevsky?

Alexander Nevsky is Novgorod Prince and military leader. Prince Novgorod (1236-1240, 1241-1252 and 1257-1259), Grand Prince of Kiev (1249-1263), Grand Prince Vladimir (1252-1263). He plays a special role in the history of Russia. In all his life he has never lost a battle. He was considered a favorite Prince of the clergy, a national hero, truly Christian ruler, guardian of the Orthodox faith and freedom of the people (figure 1). He can be briefly described as a talented diplomat, commander, who was able to protect Russia from many enemies, as well as to prevent the trips of the Mongol-Tatars.

Analyzing Alexander Nevsky feat we can realize that his Christian duty and civic responsibility were moral and strong. By means of his example, Alexander Nevsky gives the image of education of a whole, spiritual and moral personality – as Christian, family man and citizen. A huge role in the education of spirituality and morality in high school is given to the teacher. With his attitude to the Motherland, people and Orthodoxy, he presents the way to successful personal development and person's spiritual and moral values formation.



**Picture 1. Icon of Alexander Nevsky**

"The events of recent years have shown that we have lost a lot. We have forgotten how to live according to the laws of our ancestors, in the Christian spirit – as God commands and Holy Church teaches. We have lost the old foundations and continuity of the traditional way of life and we have to restore it if we do not want spiritual and moral degradation and degeneration. Among the many tasks facing the Russian society today, the most important is the restoration of the historical memory of the people, the Orthodox faith, with its associated values, ideals, moral guidelines, national

traditions in social, family life and in the upbringing of children" [7, www].

Thus, the huge role of saints in the spiritual and moral development of the individual is obvious, since the ideal of its spiritual and moral development reflects the humanistic system of values.

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**Аннотация.** Целью данного исследования является определение роли святых в духовно-нравственном формировании молодежи, поскольку идеал духовно-нравственного развития личности выражает гуманистическую систему ценностей. Примеры святых, святости, патриотизма, доблести и успеха имеют огромное влияние на духовно-нравственное развитие личности. На примере бессмертного подвига великого князя Александра Невского показан образ воспитания цельной, духовно-нравственной личности – как христианина, семьянина и гражданина.

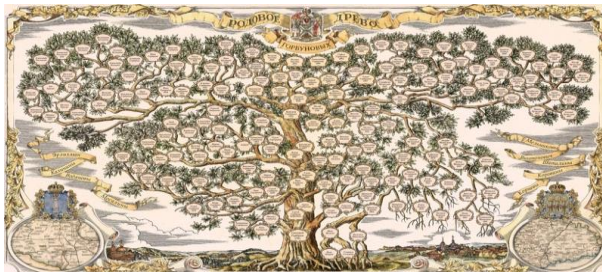
**Ключевые слова:** Александр Невский, икона, великий князь, Владимир Мономах, православное сознание, духовно-нравственное развитие, святость, христианский правитель, православная вера.

**Summary.** The purpose of this study is to determine the role of Saints in the spiritual and moral development of youth, since the ideal of spiritual and moral personal growth expresses the humanistic system of values. Examples of Saints, Holiness, patriotism, valor and success have a huge impact on the spiritual and moral development of the individual. On the example of immortal feat of Grand Duke Alexander Nevsky the image of education of spiritual and moral personality as a Christian, family man and citizen is shown.

**Keywords:** Alexander Nevsky, icon, Great Prince Vladimir Monomakh, Orthodox consciousness, moral and spiritual development, Holiness, Christian ruler, the Orthodox faith.



## SECTION 12: CULTUROLOGY AND GENEALOGY



UDC 929.52

### IN MEMORY OF PROFESSOR GUSEV VLADIMIR ALEXANDROVICH

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**Introduction.** Gusev Vladimir Alexandrovich (photo 1) was born on August 27, 1941 in Ussuriysk, Primorsky Krai. Became an orphaned early: father – Gusev Aleksandr Loginovich, a red Army officer have died on 30 April 1945, a month before his mother – Guseva Anna Petrovna died. Was given to the orphanage, and then became the son of a Colonel of the musical platoon of the Soviet Army. In 1958 he ended the middle school in Kraskino village, Khasan district, Primorsky Krai.



Photo 1 – V.A. Gusev

**Main part.** In 1959, V.A. Gusev entered the Kiev Polytechnic Institute, which he graduated in specialization "Dielectrics and semiconductors", and held a competition in graduate school. After defending his candidate thesis, he was appointed to the laboratory "Electronstandart", the city of Leningrad. In 1969, for family reasons, he moved to Sevastopol and was elected associate Professor of the Department

"Semiconductor devices" of the Sevastopol Institute of construction (SIC), the head of which was elected in 1972.

Twice – in 1973 and in 1977 – he passed scientific training in the USA— in Princeton University, c. Princeton, and in Massachusetts Institute of technology MIT (Lincoln Laboratory), c. Boston, as a visiting Professor.

From 1975 to 1979 he was the vice rector for scientific operation SIC. In 1982 receives the doctoral dissertation which was devoted to design and manufacturing techniques of injection semiconductor items, and in 1984 he was entitled professor of department of semiconductor and microelectronic systems.

From 1999 to 2004 he worked as the dean of the newly created faculty of radio electronics of Sevastopol State Technical University, and then, until the last days of his life, he headed the department of electronic engineering of SevSU.

The results of the fruitful scientific work of Vladimir Aleksandrovich Gusev were noted in 1990 by the state Premium of the USSR Council of Ministers for the development of CAD silicon varicap. During the research SPI V.A. Gusev led research on the program of defense Ministry of the USSR "Official use of marine animals", in the performance of which the contractors were the leading scientific institutions of the USSR: Institute of brain as the USSR, Leningrad, Institute of Cybernetics as USSR, Kiev, KPI, KB "Storm", Kiev, LETI, OKB BIMK (biomedical cosmonautics), Leningrad, W/h 13132-Dolphinarium of the Soviet Navy, Sevastopol, etc.

Led by Professor Gusev scientific staff of the Department has developed methods for calculating the optimization of a new class of silicon transistors CT 814 series, which were produced at a number of enterprises of the electronic industry of the USSR.

In recent years Gusev V.A. was actively engaged in development of theoretical bases of defect-impurity nanotechnology of a new class of highly effective silicon solar cells with charging pumps, together with the Institute of problems of microelectronics technology of the Russian Academy of Sciences. The results obtained by him were the basis of the project on the prospect of implementing ideas for the large-scale introduction into the industry of a new element base of ground-based solar energy with a gigawatt installed capacity.

Within the framework of the scientific school Professor Gusev V.A. prepared more than 20 candidates and doctors of technical Sciences. During the whole period of his career he published more than 300 works, including 4 monographs and textbooks, received 56 author's certificates of the USSR and patents of Ukraine.

Conclusion. The tragic death of Professor Gusev in January 2016 interrupted the bright life path of an outstanding scientist and teacher, the memory of which will remain in the affairs of his students and associates.

**Аннотация.** Настоящая публикация посвящена жизненному пути и научным достижениям бессменного руководителя кафедры «Электронная техника», доктора технических наук, профессора Гусева Владимира Александровича.

**Ключевые слова:** В.А. Гусев, кафедра полупроводниковых устройств, кафедра «Электронная техника».

**Summary.** This publication is dedicated to the life and scientific achievements of the permanent leader of the Department of Electronic Engineering, Doctor of Technical Sciences, Professor Vladimir Alexandrovich Gusev.

**Keywords:** V.A. Gusev, department of semiconductor devices, department of electronic engineering

UDC 392.311

## **THE STORY OF MY FAMILY BEING THE PART OF THE HISTORY OF RUSSIA: FAMILY TRADITIONS AS A SOURCE OF PATRIOTISM FOR A CITIZEN OF RUSSIA**

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A family has a special function in the society. It should serve as an intermediary between the individual and the clan, educate the younger generation in the spirit of the traditions of the clan. It is said that "every modern family is preparing the society of the future", but at the same time "as a cell of the existing society it prolongs the life of a society in present". It is in the family that people acquire the experience of historical continuity and learn to pass on from generation to generation property and accumulated knowledge. Continuity of generations is the most important "condition of civilization", ensuring fidelity to traditions, and thus order and harmony. That was the opinion of the great French philosopher and sociologist Auguste Comte which he expressed in his work "System of Positive Polity" [1].

That's why in our family we are trying to keep track of our roots, to transmit the information from generation to generation. Unfortunately, no one in my family before me has carried out detailed systematization of information about our ancestors; as a result a lot of priceless information has sunk into oblivion together with the eyewitnesses who carried them. Nevertheless, I managed to collect enough material about five generations of my family, dating back to the second half of the 19th century.

So, my maternal line great-great-grandfather Leib (Leo) Grinberg



(born in 1874) belonged to the estate of the guild merchants of Tulchin (a town of the Bratslav district of the Podolsky province), his father traded with large cities in the south of the Russian Empire, as well as with foreign countries. Leib himself received a brilliant education, he possessed encyclopedic knowledge, and he spoke Russian, German, French, Polish, Ukrainian, and Yiddish.

In the prime of his career he was a major forestry official. He is a Jew by nationality. Participated in the turbulent events that took place in Tulchin during 1917-1920, when the city was in power of the Bolsheviks, Denikin, and Austro-German troops. Leib lost his fortune, but escaped during the brutal massacre, committed by a large bandit formation led by Lyakhovets on the night of July 31 to August 1, 1919. He gladly accepted the revolution.

His wife, Rosa Greenberg (1880 - 1950, Tulchin) was also Jewish. After graduating from the school for girls, she, like her husband, spoke Russian, German, French, Ukrainian, Yiddish. After marriage, she became a housewife, later - the mother of five children (Kisil (Cyril), Gabriel (Grigory), Shendle (Eugene), Anyuta Judel (Anna), Elizabeth (my great-grandmother)).

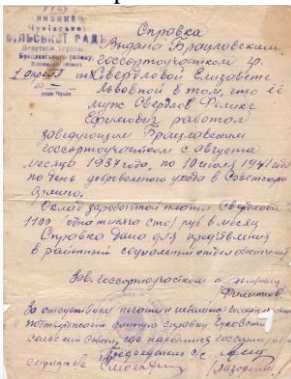
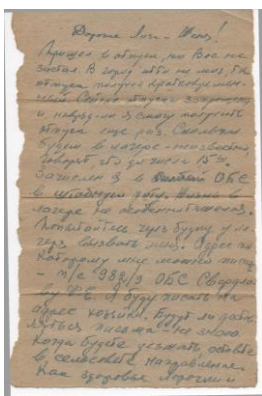


The youngest daughter, Elizabeth Leybovna (Lvovna) was born in 1915 in the city of Tulchin, Vinnytsia region. She lived and studied in Tulchin, then went to receive higher economic education in Kiev. She was the youngest in the family. Her conscious childhood and youth, unlike her sisters and brothers, passed in Soviet times. She was an ardent pioneer and a Komsomol member, even refused to eat sunflower seeds, because at that time "scrounging" seeds was considered a sign of philistinism. Returning to her native Tulchin, she

began to work as an accountant. She spoke Russian, Ukrainian, German. In

1937, she was married to Felix Efimovich Sverdlov (born in 1911), a native of Uman, the Kiev region.

After receiving a higher biological education, young Felix became a talented scientist - a plant selection breeder, the head of the Bratslav state crop-testing station. Near the house Felix created a wonderful and unusual garden, where on one tree, thanks to top grafting, apples and pears, sweet cherries and cherries grew simultaneously on different branches. Its high-yielding varieties of wheat were presented at VDNKh. Russian by nationality (parents: Yefim Sverdlov, Russian, Raisa Alekseevna Sverdlova (born in 1852), Russian, further information is unknown), he came from a professorial family, possessed encyclopaedic knowledge, spoke Russian, Ukrainian, German and French. In 1941, despite the exemption from active



duty, he volunteered for the front. Until 1944 he was considered to be missing in action, but later it became known that Felix had been killed in battle in 1941. Here is the only letter to his family that he wrote after leaving the army on a scrap of wallpaper:

Unfortunately, only a few photographs of my great-grandfather and his parents were preserved, since practically all the family belongings disappeared during the war (except for part of the family relics and few photographs buried in the garden before the evacuation). Elizabeth with an infant (my grandmother Leonora Feliksovna) in her arms and the most

necessary things hastily left Tulchin before its occupation and went to Kurgan, where her elder brother Gabrusya and her sister already moved. On the train, all her things were stolen, but she still managed to get to her relatives and save her 9-month-old daughter, my grandmother. In Kurgan my great-grandmother worked as an accountant in a kindergarten. In the postwar period, Elizabeth lived and worked in Tulchin, where in 1970 she died from diabetes.

The life of Lisa's brothers and sisters was no less rich in events: for



example, Anyuta Yudel Leibovna (Anna Lvovna) Grinberg (1908, Tulchin - 1999, Kiev), a chemical engineer, during the Second World War was evacuated to Kurgan together with the plant. At the plant, Anna developed a technique for making matches in the most economical way,



which was extremely important during the war and post-war period. She also made rubber toys for children, some of which are kept in our family to this day.



Unfortunately, Anna's fiancé, same as her sister Evgenia's, died at the battle-front. Both women were faithful till the end of their lives to their beloved, who had been taken away from them by the cruel war: they did not manage to experience the happiness of married life and motherhood. Despite this, Nyusya and Zhenya dedicated themselves completely to the care of their sister Lisa's family: my mother remembers her grandmothers with warmth and love, speaking of them as the best friends of her childhood.

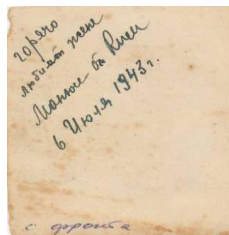


Gabriel Leibovich (Grigory Lvovich) Grinberg (Tulchin-1979, Kiev)



during the Second World War was the head of the military plant evacuated from Kiev to Kurgan.

Gabriel with his wife.



The evacuation of the factories was carried out in difficult conditions: it was necessary, on the one hand, to ensure as long as possible the production of the goods necessary for the front in the initial place, and on the other hand, to succeed in moving away people and equipment before the arrival of the Germans. Sometimes people worked in already mined workshops in case of the enemy's break-through.



Kisl Leibovich (Kirill Lvovich) Grinberg was a military doctor, a major, a veteran of the Second World War. Having reached Berlin in 1945, he signed at the Reichstag, leaving



a reminder of his contribution to the Great Victory for the centuries to come.

The only daughter of Elizabeth Lvovna, Leonora Sverdlova, my maternal line grandmother, was born in Tulchin in 1940. In 1941-1944 she was evacuated to the city of Kurgan with her mother.



From 1944 to 1957 she lived and studied in Tulchin. She graduated with honors from school, represented Tulchin at various Olympiads and conferences.





In 1957 - 1959 years she received a paramedic education in the Leningrad Medical School, then, in 1960- 1966, graduated from the Leningrad Sanitary and Hygienic Medical Institute, specializing in epidemiology.

In 1964 she was married to a Ukrainian, Lelyukh Georgy Danilovich, my grandfather (born in 1940, Kramatorsk, Stalin region, the Ukrainian SSR)

From October 1941 to September 1943 he was in the occupied



Kramatorsk. In the house of little Georgy, the Germans lodged, and the family huddled in a dilapidated shed. Once my 4-year-old grandfather was within a hair's breadth of death, having grabbed a chocolate bar lying in a fascist car. Fortunately, the soldiers heeded the tearful pleas of mother of Georgy Olga and spared her only son, firing a burst not at the boy, but in the air. Later, George graduated from school in Kramatorsk, and in 1957 - 1959. received a medical assistant's education in the Donetsk Medical School. In the years 1959-1960 he served in the airborne troops and completed 12 jumps with a parachute.



In the years 1960 – 1966 he studied at the Leningrad Naval Medical Academy, at the same time he met Leonora Sverdlova, and then married her. In 1966, the newlyweds moved to Sevastopol, where Leonora began working as an epidemiologist, and Georgy – as a military surgeon of the Black Sea Fleet on a submarine in Balaklava. Leonora's family, including cousins Lyudmila Grigorievna Nissenberg (Grinberg) and Rosa Grigorievna Rosenberg (Greenberg), lived in Kiev. After the largest man-made disaster in history on the Chernobyl nuclear power plant (1986), Lyudmila and Rosa and their families emigrated from Kiev to Los Angeles, where they still live. Their children, Mikhail and

Oleg, have received higher education and work according to it. Oleg graduated from school and later medical institute in the US. Michael's son, Andrew is my peer. Recently we managed to restore contacts by finding each other in the social network Facebook. His native language is English, he hardly speaks Russian. He is a talented musician, plays the guitar in a jazz band.



Leonora stayed in Sevastopol, she worked, she was engaged in housekeeping, she was raising two children (Felix Georgievich, born in 1966 and Liya Georgievna, my mother, born in 1970) until 2010, when she died of a heart attack at the age of 69.

Georgiy from 1983 to 1993 served as the chief otorinolaryngologist of the Black Sea Fleet, the head of the ENT department of the Pirogov VMKG. From 1993 to 2017 he was a captain of rank 1 in reserve, an ENT doctor in 110th polyclinics. Currently he is retired.



Let us take a look at the family which my grandfather comes from. His mother's clan originated (according to the information available to us) in the village Novosandjary of the Kharkov region from Ignat Feoktistovich Ovcharenko (1876 Novosandjary - 1972 Kramatorsk), the Don Cossack. In 1904-1905 years Ignat served in the Don Cossack division in the rank of sergeant and participated in the Russo-Japanese War.



In the years 1918-1919 during the Civil War he participated in the proclamation of the Don Cossack Republic, took part in battles. During the First Five-Year Plan (1928 - 1932), he was dispossessed and deported from Stanitsa Gundorovskaya,

Donetsk. He settled in Kramatorsk, where he stayed during the occupation of the city in 1941 - 1943, and then lived and worked until his death at the age of 96 years.



He had 19 children, including Georgiy's mother, Ukrainian Olga

Ignatyevna

(Novosandjary 1914 - Kramatorsk, 2007).

A housewife and a

mother of four children (senior Georgy, Valentina, Boris, Leonid), she had only primary education. She lived and worked in the village, Novosandjary, Kharkiv region, later in the city of Kramatorsk. She was married to a Ukrainian, Danil Yakovlevich Lelyukh (1912 Bliznetsy, Kharkiv region - 1975 Kramatorsk).



During the Second World War Danil volunteered for the battle-front as a private soldier. Near Kharkov in October 1941 he was wounded and taken captive, but later escaped and returned to the front. Olga from October 1941

to September 1943 was in the occupied Kramatorsk. Her brother, Danil Ignatievich, served in the cavalry as a foreman and participated in the liberation of Belgrade (Yugoslavia). After the war, Olga lived with her husband Danil (worked as a cabinetmaker, according to his secondary special education) in Kramatorsk, where



she died at the age of 93, continuing the tendency of longevity of the Ovcharenkos and Lelyukhs, started by Ignat Feoktistovich.

The children of Georgy and Leonora, Felix (born in 1966, named after their grandfather killed at the battle-front) and Liya (my mother, born in 1970, named after her grandmother Elizaveta) received a wonderful education. Both were excellent pupils at school, loved to read. In 1987 Liya entered the Frunze Simferopol State University, the Faculty of Biology, and graduated in 1992 with a prestigious diploma. From 1983 to 1988 Felix studied at the Popov Higher Naval School of Radio Electronics in Leningrad, RSFSR (specialty engineer-mathematician), side by side with the future husband of my mother, my father Yuri Ruslanovich Bariev.

By a lucky coincidence, Yuri (born in 1966 in Rudny, Kazakhstan) arrived in Sevastopol in 1988 for military service, where he met his best friend Felix's sister Liya. A year later, on August 5, 1989, the young lovers got married. Yuri began to serve in the armed forces of the USSR, and Liya - to study at the university, and then work as a bacteriologist in the sanitary-epidemiological station. In 1991 there was a huge upheaval, both in the world and in the life of our family - after the collapse of the Soviet Union, Sevastopol servicemen were assigned to two fleets. So, my father began to serve in the armed forces of Ukraine, and my grandfather and uncle - of Russia. At the time of the second coup d'état, namely, the annexation of the Crimea to Russia, my father was the captain of rank 1 in reserve (since September 2013). Currently, Yuri is a civil servant, head of the information technology department of the government of Sevastopol, and Liya is a bacteriologist in the Mother and Child Health Center.

Let us turn to the family of my father, Yuri Ruslanovich Bariev. Yuri's grandfather, Rauf Bariev (born in 1900), was a thoroughbred Tartar born in the county town of Guryev in the territory of the Ural Cossack Army. From 1917, he was a member of the Muslim Committee of the city of Guryev, who supported the fall of tsarism as a result of the February revolution. At the end of 1918 the Soviet power was finally established in Guryev. In the spring, when the White Cossack army of General Tolstoy occupied Guryev, Rauf joined the Red Army. In Guryev there was a strategically important oil reserve, which the White Cossacks, retreating, were going to burn. To prevent this, in 1919 Vladimir Ilyich Lenin ordered to commit an offensive in the Guryev direction to prevent arson. Shortly thereafter, an epidemic of typhus broke out in Guryev, killing half the city's citizens. Rauf was lucky enough to survive the epidemic, and as soon as in January 1920, as part of the 25th Chapayev Red Banner Rifle Division, my great-grandfather participated in the liberation of Guryev.

Later Rauf married Sarvar (born in 1900, Guryev, thoroughbred Tartar), became the father of eight children (Ruslan (my grandfather), Reshat, Raphael, Farid, Marat, Hamid, Rafkat, Lyalya). In 1941, during the Great Patriotic War, he went to the battle-front as a private soldier. He died in the 1950's due to the undermined health.



By the will of fate, all the children of Rauf and Sarvar, with the exception of one son, interrelated with Russians. This was a personal tragedy

for Sarvar. So, a single woman at that time, she deprived herself of the joy of communicating with grandchildren born of Russian women, including my father. In her old age, Sarvar realized her mistake, resigned herself to the inevitable, and my father's younger brother, who resembled her



husband in appearance, visited her (without his mother and older brother, whom she did not recognize). So, as we have already mentioned, Ruslan Raufovich (1939, Guryev - 1995, Rudny) married a Russian woman. This happened in 1965 in Rudny, Kazakhstan, where young Ruslan and his two older brothers, having received secondary education, enthusiastically

joined the youth construction works. There, my grandfather was a worker in the Sokolov-Sarbaevsky ore mining and processing plant, mining ore. Heavy work and harmful working conditions undermined Ruslan's health and led to his untimely death at the age of 56 from asthma.

In the photo from left to right: grandmother Valya, grandfather Ruslan, great-grandfather Ivan, in the center - my father.

His wife, Valentina Ivanovna Kuzmenkina, was born in 1940 in the village of. Shipunovo, Krutinsky district of the Omsk region of the USSR. Then, like Ruslan, she moved to Rudny to work at the ore mining and processing plant. She received only primary education, later worked as a saleswoman before retirement. She is a mother of two children (Yuri Ruslanovich, my father, born in 1966, Vladimir Ruslanovich, born in 1972). Currently she lives in Rudny, Kazakhstan.



The life of Valentina's parents is no less interesting: for example, her



father, Ivan Mikhailovich Kuzmenkin (1915 Kabanie, Krutinsky district, Omsk region - 2004 Rudny, Kostanay region, Kazakhstan), having received primary education, in the 20s-30s years worked on the collective farm. There he met Maria Egorovna Bogazhova (in 1912, Kabanie - in 2002, Rudny), who he soon married. In 1941, Ivan went to the battle-front, where he lost his hand, and for this reason he returned

to the village of Kabanie.

During the war, Maria worked in the rear, working on the collective farm and forestry. At that time, 38% of the able-bodied agricultural workers left to the army, ie, almost all men of the call-up age. In many villages there were no more men younger than 50-55 years old. In 1943, 71% of agricultural workers were women. Next to them, old men and teenagers worked. The majority of machine operators were called into the army (after all, a tractor driver is practically a well-prepared tank driver). Women, including Maria, had to master the tractor. Great-grandmother told me that after the war the Siberian village, where there were neither bombings, nor occupants was in a terrible condition. The victory was met by women, disabled and teenagers, exhausted with excessive labor, who had to work not only on horses, but also on cows from the first days of the war. There was no payment for workdays, the ration was only 500 grams per worker, and the family had small children. Often rations were given not in bread, but simply in oatmeal, from which they prepared 'zatirukha' for the whole family. As a result, having worked hard all her life, Maria received a meager pension.



In 1964, Ivan and Maria moved to Rudnyi to their children (Victor, Mikhail, Nadezhda, Valentina (my grandmother)), where they lived the remaining half of their long lives, staying active and capable even at 90. They gladly celebrated the Golden wedding, traditionally dressed as a bride and a groom.

We are a multinational family and, although we consider ourselves Russian, we honor the traditions of our distant ancestors. On holidays we prepare some national dishes: chebureki, beshbarmak, shurpa, forshmak, stuffed fish, pelmeni, vareniki, draniki. From generation to generation, we pass on the ancient relics, which are truly sacred for us. Among these things

is a huge folio with rich illustrations "Animal Life" by the zoologist A.E. Brema, 1901 edition, the old gold watch of my great-great-grandmother Rosa (1905, passed on from mother to daughter), rubber toys made by my great-grandmother Anna during the war, as well as photographs and letters, some of which were included in the work.

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**Summary.** The article is dedicated to the genealogical study of five generations of the family of a student Barieva Yuliya. The information about her ancestors on both maternal and paternal lines dating back to the 19<sup>th</sup> century is presented. The data is confirmed by the photos and documents added to the article. Being part of a multinational family highly influenced by military actions, the author of the article concludes that tracing one's roots and preserving family values is the first step towards patriotism of a citizen of Russia.

**Key words:** family, genealogy, culturology, patriotism, multinationality, values.

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## 1. Introduction

Kurmel Anatoly Petrovich (photo 1 from archive of RT department, 1980) was born on August 24, 1920 in Leningrad, where he graduated from school and in 1939 entered the architectural department of the Leningrad Institute of civil engineering. But life makes its own adjustments-so November 1, 1939, a first-year student is called to the Red Army for a special Voroshilov set. Youth soon ended and from December 1939 to March 1940 Anatoly had to participate in the Finnish war. And the world already has stopped for in anticipation something terrible-in June 1941 began the Great Patriotic war.

## 2. Main part



Photo 1 – Kurmel A.P.

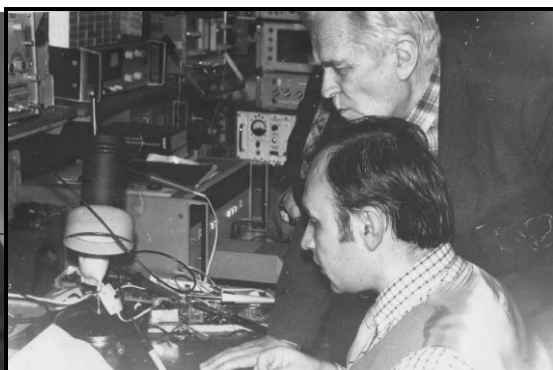


Photo 2 – Assistant V.M. Iskv and A. P. Kurmel design laboratory stand (photo from archive of RT department, 1994)

Anatoly Petrovich met the Great Patriotic war in parts of the Leningrad front, exactly in the 169-th antiaircraft artillery regiment. The whole country watched the fate of the historic city. Kurmel A.P. was among those who defended the southern direction of Leningrad in the air defense forces (PVO), he participated in the breakthrough of the blockade and the liberation of the city on the Neva from the Nazi invaders. In 1945 — the year of the great victory — there is hope for a bright, serene life. Anatoly Petrovich decided to devote himself to the army: he continued his service in the Leningrad air defense army, and in 1958 he was sent to the Crimean air defense division as a senior officer of the combat control of the anti-aircraft missile troops. During these years, major Kurmel is on combat duty, watching American reconnaissance aircrafts, violating the silence of the blue sky of the Crimea. In 1969 Kurmel A. P. left in a stock in a rank of the Lieutenant Colonel. From April 1970 to May 2007 Anatoly Petrovich worked in Sevastopol Instrument-making Institute at the department of radio engineering in various engineering positions (photo 2). More than



twenty commendations recorded in his service book. But the most important thing in his life is a television technique. An excellent specialist, a conscientious worker, a highly intellectual educator and just a good person — these are the few human qualities that were inherent to Anatoly Petrovich.

### **3. Conclusion**

Holder of the order of the red Star, Patriotic war of I and II degree, Bogdan Khmelnsky. Our dear Anatoly Petrovich 37 years and provided the quality work of the laboratory of television. Kurmel Anatoly Petrovich is buried in Sevastopol.

**Аннотация.** Настоящая публикация посвящена героическому жизненному пути кавалера орденов Красной Звезды, Отечественной войны I и II степеней, Богдана Хмельницкого, инженера кафедры радиотехники (РТ) Севастопольского приборостроительного института (Севастопольского государственного технического университета, Севастопольского национального технического университета) Курмеля Анатолия Петровича.

**Ключевые слова:** Курмель Анатолий Петрович, Великая Отечественная война, Севастополь, приборостроительный институт, радиотехника.

**Summary.** This publication is dedicated to the heroic life of a knight of the order of the Red Star, Patriotic War of I and II degree, Bogdan Khmelnsky, engineer of Department of Radio engineering Sevastopol Instrument-Making Institute (Sevastopol State Technical University, Sevastopol National Technical University) Kurmel Anatoliy Petrovich.

**Keywords:** Kurmel Anatoly Petrovich, Great Patriotic war, Sevastopol Instrument-making Institute, radio engineering.

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## A SOLID FAMILY IS A FOUNDATION OF A STRONG STATE

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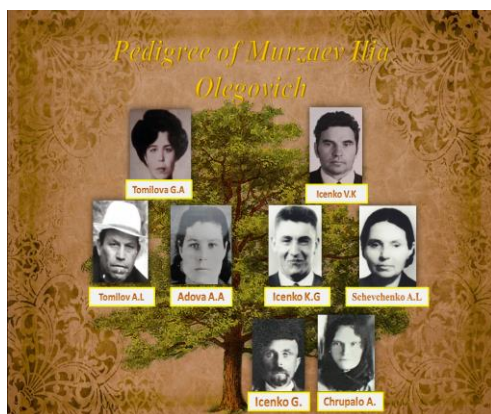
Since the ancient times people have studied their genealogy, not only because of curiosity, but also from vital necessity. Only the noble people used to be engaged in tracing their genealogy as they needed the proof of their belonging to the noble family.

Nowadays many people start to trace back their roots to show the future generations the story of their ancestors.

Previously I was not bothered by such questions. Only becoming a

student, I realize how important is to know your family tree. I am grateful to Tatiana Vasilievna Smirnova, PhD in History of Arts, for supervising my research.

The story of my grandmother and grandfathers seemed bright to me. In the 1900-s the life of peasants in Ukraine was characterized by a shortage of land, so the people



began moving from Ukraine to the Urals. Three brothers Izenko - Demyan, Isai and Eftey - my great-grandfather (1888), together with other Ukrainians bought a piece of land in Orenburg Cossack district (between Troitsk and Chelyabinsk - 600 hectares for 250 rubles per hectare). Grandfather Eftei had two sons - Vasily and Gordei. Great-grandfather Eftey died early, so Gordei remained a ten-year-old boy without a father with his mother and

brother Vasily, aunt Oprosinya and aunt Anna. They lived and worked together in one farm, worked on land and raised cattle.

Children from childhood worked on an equal basis with adults. At the age of 10 he took a cow to the market in Troitsk on behalf of his father and sold it for 5 rubles. There was a tractor in their farm, which Gordei could operate. At the age of 12 he started plowing independently. Once he fell asleep while the night plowing, and the tractor collided with the birch, stood "on end", the engine continued working until Gordei woke up. He had to become the leader of the family from the very childhood.

In the years of 1906-1907 Gordei married a native of the Taurian Kherson province Khrubalo Akulina. The bride was from a wealthy family, she married my grandfather without parental blessing, "ran away," Gordei took a pair of his horses and stole the bride. There were about 17 families in the farm Shalaumovo, not far from Troitsk, where the family raised seven children.

It happened so that in 1930 the family of Isenko Gordey Efteevich was declared as "kulak" and deported to a special settlement in the Kizilovsky coal basin. By the time of this deportation there were only one tractor, 8 horses, 10 cows. The "kulak" families were loaded into a car, the train of 60 cars was sent deep into the Urals, to the station of the Usva of the Perm Region, to the Demidov Mine, where (without passports) they worked for nearly 17 years. People lived in "barracks", with the small oven and one lamp in the middle of it. Working conditions were very heavy, the miners worked in the water, there were no showers, they suffered heavy losses. People were "explained" that they were brought there to be punished. They died from starvation and diseases (typhus, dysentery). People suffered from unusual natural conditions: heavy frosts achieved 50 degrees. Relatives were not allowed to send them food. Due to unbearable conditions the miners began to run without documents. So Gordei Efteevich with his son Kiril tried to escape. But as it was impossible to live without the whole family, they had to return. To feed themselves, they developed the gardens on small pieces of land on mountain terraces.

Since the year of 1934 living conditions were improved. They began to receive meat, butter, cereals, some clothing for their children. Accordingly, the norms of coal production were also increased. My great-grandfathers became the leader of labor, he could reach even 200% of the rate of production. For such results he was "awarded" with some cuts of clothes.

From 1945-1946 they were restored in civil rights, and were allowed free exit. Isenko Kirill Gordeevich, Pelageya (Polina) Gordeevna and Anna Gordeevna, the younger one, settled in the village of Tarutino (the Chelyabinsk region). Then in the next decade – I'm proud – my great-

grandfather Kirill Gordeevich for his long working in the mine was awarded a medal "For the laborious work during the Great Patriotic War"

Pedigree of the family Itenko (Tomilova) Galina Alekseevna. The entire family of Tomilovs are real Siberians, they lived in the city of Iskitim. Alexander's great-grandmother, a native of Iskitim, together with his great-grandfather Matvei Nyfyodovich kept the farm of their own: cows, horses, chickens, geese. There was a big garden that gave them rich harvests. They made their sour cream, milk, cottage cheeses. Grandma Alexandra had four children - Anastasia, Maria, Ivan and Andrew. Andrew added one year and went to the front with his friend Alexei Lavrentievich - the father of my grandmother. A year later, a letter from the military authorities arrived, stating that Andrei was MIA in 1942. Aleksei Lavrentievich took part in battles for Stalingrad, Kursk Duga, and for Berlin. Great-grandfather was injured for several times, but he was able to reach the victorious end. But a piece of a grenade in his leg for sixteen years. He had many awards.

My great-grandfather did not like to talk about war. He had too much to go through, too much for one person. From my childhood the stories of my grandfather and grandmother are in my memory, among them there is the story about how my great-grandfather fell asleep in winter, having only his coat on, but survived.

I conducted independent research about my great-grandfather heroic past which included gathering information from books or learning from elderly veterans' live narrations as well as looking through my old family photographs. I was deeply impressed by the battle at Kursk in which my granddad participated gloriously. That was the largest tank battle in war history and the tipping point of the whole war. About 2 million soldiers, 5 000 tanks and about 3,000 planes were involved. The battle lasted for 11 days. Veterans recall that battle as a real hell on Earth - the place where the armor melted. Constant bombardments, artillery, tank rams and melees, there was everything that only the military genius of man had created. I am proud that my great-grandfather took part in such a crucial battle that seriously affected the entire course of the Great Patriotic War and the whole world war in general, and for the feat shown at Kursk Duga, he was awarded by the Order of the Patriotic War of the 1st degree.

My great-grandmother Anastasia worked at the aviation plant as a foreman throughout the war, helping to forge victory in the home front, where conditions were not even better than at the battle-front. There was cold, hunger, food was received on cards and it was not enough. Losing a card was meant dying of starvation. Security measures at the Soviet home front factories were harsh. Heads would roll if a worker would be late for

his shift – Stalin`s regime needed to win the war over the Nazis and people were eagerly participating in the fight against fascism.

After the war, my great-grandfather married Anastasia, the mother of my grandmother. Five children were born in their marriage - Peter, Galina (my grandmother), Elena, Victor and Anatoly, who kept on the honorable pedigree of my family which is an integral part of the history of my Motherland, my real great pride and glory of my future generations.

**Аннотация.** Автор представляет факты из истории своей семьи. Рассказано о героическом подвиге деда во время Великой Отечественной войны.

**Ключевые слова:** Великая Отечественная война, семья, битва под Курском, будущее поколение.

**Summary.** The author presents facts from the history of his family. It is told about heroic feat of the grandfather during the Great Patriotic war.

**Keywords:** Great Patriotic war, family, battle of Kursk, future generation.

## A collage of various social scenes and symbols surrounding the word 'Sociology'. The word is written in large, stylized letters. Around it are images of a city skyline, a person in a suit, a person in a lab coat, a person in a military uniform, a person in a police uniform, a person in a wheelchair, a person with a dog, a person with a child, a person with a baby, a person with a stroller, a person with a shopping bag, a person with a suitcase, a person with a backpack, a person with a camera, a person with a microphone, a person with a megaphone, a person with a sign, a person with a flag, a person with a banner, a person with a poster, a person with a book, a person with a newspaper, a person with a magazine, a person with a CD, a person with a DVD, a person with a video, a person with a photo, a person with a drawing, a person with a painting, a person with a sculpture, a person with a statue, a person with a monument, a person with a building, a person with a bridge, a person with a road, a person with a train, a person with a plane, a person with a ship, a person with a car, a person with a motorcycle, a person with a bicycle, a person with a skateboard, a person with a roller skis, a person with a snowboard, a person with a surfboard, a person with a kite, a person with a balloon, a person with a flag, a person with a banner, a person with a poster, a person with a book, a person with a newspaper, a person with a magazine, a person with a CD, a person with a DVD, a person with a video, a person with a photo, a person with a drawing, a person with a painting, a person with a sculpture, a person with a statue, a person with a monument, a person with a building, a person with a bridge, a person with a road, a person with a train, a person with a plane, a person with a ship, a person with a car, a person with a motorcycle, a person with a bicycle, a person with a skateboard, a person with a roller skis, a person with a snowboard, a person with a surfboard, a person with a kite, a person with a balloon.

## SOCIALIZATION OF THE INDIVIDUAL AND THE POTENTIAL OF SCOUTING IN THE EDUCATIONAL PROGRAMS OF RUSSIA

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The public's attention to children has increased during recent centuries. The idea of creating a harmoniously developed personality (a person of high morality, hardworking, physically perfect, citizen and patriot) is popularized. Raised in this way, young people will eventually overcome class antagonism. In a healthy, full-fledged rising generation, government structures were also interested, because this is the future workforce, the army reserve [1].

The social formation of a person occurs throughout life and in different social groups. Family, kindergarten, school class, student group, labor collective, peer group are all social groups that make up the nearest environment of the individual and act as bearers of different norms and values. Such groups that define the system of external regulation of the behavior of an individual are called institutions of socialization [2].

In the broadest sense, the notion of socialization is treated as a process and the result of a person's social development. I.S. Kon believes that socialization is the totality of all social and psychological processes through which an individual absorbs a system of knowledge, norms and values that allow him to function as a full member of society [3]. The essence of the process of socialization lies in the fact that a person gradually assimilates social experience and uses it to adapt to the society. This assimilation takes

place spontaneously and purposefully. Purposefulness is determined by the efforts of the family, the school, various social organizations.

The Scout movement is a voluntary, non-political educational movement for the young, open to all regardless of their origin, race or creed. Movement means a series of organized activities carried out in accordance with the purpose. The movement, therefore, presupposes the existence of both the goal to be achieved and the specific organization necessary to achieve the goal.

The voluntary nature of scouting is emphasized by the fact that the members of the Movement enter into it of their own free will and because they accept the fundamental principles of the movement. This applies to both young people and adults. Scouting belongs to the latter type of upbringing (informal), because it takes place outside the formal system, is an organized institution with an educational purpose and addressed to a certain educational group.

Scouting should be clearly distinguished from purely recreational movement, although in some parts of the world there is a tendency to such perception of its appearance.

The purpose of the Scout movement is to promote the development of young people to achieve their full intellectual, social and spiritual potential as individuals, as responsible citizens and as members of local, national and international communities.

The study was conducted in the city of Sevastopol. A survey was conducted of a population group (11 people) aged 12 to 60 on the topic "The Importance of the Scout Movement in Russia" (see table 1).

Table 1. – Sample of questionnaire

QUESTIONNAIRE	
Surname, first name	
years	
<b>1. In your opinion Scouting is</b>	
A) system of education of children, adolescents and youth through the creation of public organizations. The main goal of the system is the education in the young generation of devotion to their country, government, Christian faith.	
B) the most brilliant pedagogical method used by scout leaders to organize their free time, as well as the free time of children and other idle youth in accordance with their needs and interests.	
C) a great and wonderful world of friendship, purity and comradeship. These are sunrises and sunsets. These are songs, hikes, a feeling of oneness with nature. This intense and sometimes "extreme" communication, these are difficult weather conditions, when you need to do business together.	
<b>2. Do you consider Scouting an important element of leisure and socialization of the individual?</b>	
A) No. Scouting is an element of the industry of Western culture, it is	

alien to the Russian youth.
B) Yes. Scouting is one of the most effective forms of organization of leisure, contributing to the formation of high moral principles in every person, giving practical experience of survival in the modern world.
C) Yes. Scouting as a phenomenon of social and pedagogical reality is in demand in the Russian educational space for a century, but it must be transformed taking into account the present.
<b>3. Is the role of parents important in the Scout movement?</b>
A) No. This is a game in which there is no place for parents.
B) Yes. A great role in uniting the family is played by the traditions of joint leisure of parents and children.
C) Yes. Scouting complements the educational impact of the family, acting as its partner in the education of children and young people.

The results of the questionnaire are summarized in the table 2:

The study conducted, determined not an unambiguous attitude to "scouting", as a process of education.

The problematic field of research is caused by contradictions:

– for the age group from 12 to 18 years, "scouting" is an element of song entertainment, hiking, a feeling of unity with nature, without the participation of parents;

– the age group from 18 to 45 years considers scouting as a system of education, with the obligatory condition for the creation of a public organization, i.e. controlled state. The participation of the family in this process is compulsory;

– in the age group from 45 to 60 years, the opinion is dominated that "scouting" is a system alien to the Russian society, perhaps this is due to historical experience, namely, the existence of the pioneer organization in which the participants polled by me were.

Table 2. – The results of the questionnaire

Surname, ame of the survey participant	years	1 question			2 question			3 question		
		)	)	)	)	)	)	)	)	)
Age group from 12 to 18 years										
Agapov Cyril	2									
Slobodyanyuk Alexander	2									
Gurina Alexander	6									
Potapova Svetlana	7									
Age group from 18 to 45 years old										



Dimenko Dmitry	2									
Sukhomlinova Anna	0									
Lapikova Tamara	4									
Age group from 45 to 60 years										
Nedobyzhko Victor	8									
Roshchin Denis	2									
Vorontsova Anna	6									

Nevertheless, "Scouting" as a phenomenon of social and pedagogical reality is in demand in the Russian educational space for a century. The basis for its demand is the socializing potential contained in it, which is a systemic unity of the purpose, ways and means of organizing the life activity of a growing personality, ensuring the success of its social adaptation and individualization.

An essential feature of the realization of the socializing potential of scouting is the transformation of the teenager's life space into an educational space through the activity of the adolescent himself.

The socializing potential of scouting was most fully embodied in scout organizations operating in Russia in the first quarter of the 20th century, and then in the 1990s and the beginning of the 21st century. In the 20-80s of the 20th century, the essential feature of the realization of the socializing potential of scouting was transformed into other organizational forms of the children's movement. Moreover, having adopted the idea of "the transformation of the teenager's living space into an educational space through the activity of the adolescent himself", as well as a number of methodological tools, the children's movement in Russia existing in the form of a pioneer organization can not be recognized as an exclusively "reorganized scouting system".

In conclusion it should be noted that historical retrospect and the current state of scouting in Russia suggest that realization of its socializing potential will continue the organization of the scout movement, and its essential feature will continue to be borrowed by various associations of the children's movement. The development of the Scout movement and its place in society will be determined by its ability to update the content and effectiveness in promoting the formation of the social competence of the individual.

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**Аннотация:** В данной работе рассмотрен вопрос роли скаутинга в социализации личности. Рассмотрено влияние скаутского движения на социализацию личности. Проанализировано отношение людей различных возрастных групп к данному воспитательному процессу (на примере теста составленного автором). На основании проведенных исследований автором сделан вывод о важности использования потенциала скаутинга в воспитательных программах России.

**Ключевые слова:** социализация, социальное становление, скаут, движение, гармонически развитая личность, адаптации к социуму.

**Summary:** In this paper, the question of the role of scouting in the socialization of the individual is considered. The influence of the Scout movement on the socialization of the individual is considered. The attitude of people of different age groups to this educational process (on the example of the test compiled by the author) is analyzed. Based on the conducted research, the author concluded that it is important to use the potential of scouting in Russia's educational programs.

**Key words:** socialization, social formation, scout, movement, harmoniously developed personality, adaptation to society.

**THANK YOU FOR YOUR PARTICIPATION!**