

АНГЛИЙСКИЙ ЯЗЫК В СФЕРЕ ПРОФЕССИОНАЛЬНОЙ КОММУНИКАЦИИ

**VII Всероссийская молодежная научная конференция
Казань 15 ноября 2021 г.**

МАТЕРИАЛЫ КОНФЕРЕНЦИИ



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ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ ИМ. А.Н. ТУПОЛЕВА-КАИ
(КНИТУ-КАИ)



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СЕКЦИЯ 1

**ПРАВОВЫЕ, ЭКОНОМИЧЕСКИЕ И СОЦИАЛЬНЫЕ ПРОБЛЕМЫ НА
СОВРЕМЕННОМ ЭТАПЕ РАЗВИТИЯ ОБЩЕСТВА**

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УДК 008

VIDEO GAMES AS A NEW FORM OF ART AND MODERN ENTERTAINMENT INDUSTRY

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The purpose of this work is to analyze the future of video games as an art form and to research the effect that technological advancements have on the art spectrum.

In order to understand the future of video games as a form of art it is necessary to give a definition of what is considered to be a “video game”. Video game is a game played by electronically manipulating images produced by a computer program on a monitor or other display [1].

Video games were created as a technology in late 1940s, thanks to the advancements of analog computers. The earliest example of a video game comes from 1947 – a “Cathode-ray tube amusement device” was filed for a patent on 25 January 1947, by Thomas T. Goldsmith Jr. and Estle Ray Mann. Being constructed on the basis of radar display technology, it consisted of an analog device allowing a user to control the parabolic arc of a dot on the screen to simulate a missile being fired at targets, which are paper drawings fixed to the screen [2].

From the beginning of their mass spread in 1970s and up to late 1990s video games were seen as nothing more than a pointless entertainment aimed (mostly) at children. It is important to notice, that cinema was also originally viewed as a pointless entertainment, only with the development of sound films and the rise of story-driven movies the social view of film industry started to change. Similar to the situation with film industry, the development of the 5th generation of video game home consoles in late 1990s led to the rise of story-driven games, that both “looked and felt similar to movies”, as was stated by many video game journalists at the time. One of the most popular and critically acclaimed examples of that is 1998 “Metal Gear Solid”, released for 1994 “PlayStation” home console developed by *Sony Corporation*, – a stealth-action game with a movie-like directing and a plot that touched a lot of really serious social themes, such as pointless violence and «grey» morality of war.

Such popularity of story-driven video games could not be possible without the technical advancements of 5th generation video game home consoles. The aforementioned “PlayStation” was the first affordable home console to provide full 3D graphics and game process (utilizing vector-based graphics and allowing three-dimensional movement in 3D environment), marking a new age of 3D games. Its system was based on 32-bit RISC CPU, handling calculations of in-game physics and logic, as well as coordinating the placement of polygons and their transformations in 3D environment via Geometry Transformation Engine. The 32-bit Toshiba GPU was responsible for displaying of graphics, control of framebuffer, and drawing of polygons and textures. Compact Discs, used as a storage device for games, could store up to 660 MB of information, which allowed for usage of High-Quality music and voice clips as well as full-motion video in games. These technologies made it possible to create believable in-game cinematic scenes, filled with voiced dialogues between the characters, and through that allowed for creation of more story-driven video games [3].

From this point video games were increasingly recognized not only as mindless entertainment, but also as a way of conveying interesting ideas and talking on serious topics. In other words, video games started to be seen as an actual medium of art.

Video games, as a narrative-driven fiction, have a huge benefit in immersing the player into the narrative compared to more traditional media, such as films or literature. It is much easier to associate yourself with the protagonist of the story if you have direct control in his decisions, which only video games can provide; and such association helps creating the suspension of disbelief,

which is crucial for most of fictional media. Direct responding to player's actions is an incredibly strong instrument in the hands of a talented director.

The 2015 "Undertale" is a vivid example of that. This low-budget game developed by (mostly) only one person – an American programmer and composer Toby Fox, exploded in popularity upon its release and won the 2015 "Best Game Ever Contest" – users' choice award of GameFAQs – the respected online video game news portal. The key to that was its well thought-out story that not only could be changed drastically by player's actions, but also had the player themselves (as an actual person, playing the game) as its main protagonist and used this plot point to make a statement on humanity's obsession with controlling the life of whole worlds, both fictional and real. A story like that simply couldn't be told in any other forms of fiction. The case of "Undertale", a game created via Game Maker – a software allowing users with minimal programming knowledge to create their own games, proves that the development of software and hardware computer technologies not only leads to creation of more cinematic high-budget video games but also to the whole process of game development becoming easier for independent creators with unique artistic vision, which itself leads to the development of video games as a form of art.

Video games in the last decade suffered the same problem as many other forms of modern pop-art – the globalization of market and high profits led to the rise of high-budget mass market video game franchises that lacked almost any form of art expression and were a product of corporate design aimed not at providing ideas, but at appealing to mass audiences. The same had happened earlier with film industry and even popular literature, but it seems that the public once again strives for more auteur media, and the rise in popularity of indie games (created by independent developers) in the last few years shows exactly that. The big players of the market have already started responding to the trend: high-budget video game projects are now more often being directed by individual creators with unique artistic vision. A vivid example of that is 2019 "Death Stranding" directed by Hideo Kojima, creator of previously mentioned "Metal Gear" series. This unique, almost "art house" video game is a highly expensive artistic experiment of an individual author, starring famous film actors, such as Norman Ridus and Mads Mikkelsen and even an Oscar-winning film director Guillermo del Toro. Such inclusion of film stars and even famous directors not only in this particular project but in many other video games in the last 10 years shows that video games are truly being recognized as a respected form of art in possibly the most influential of art community. And recent often cases of big companies providing independent artist with resources and high budgets for their creations possibly marks a new age of auteur video games, similar to the age of "New Hollywood" in 1970s.

Considering all of the above, it is safe to say that video games not only have a future as a respected form of art, but also have a chance of being the most successful of all the other mediums in that regard, and the continuous technological developments of computer science, that led to creation of this media as a whole, are and will be directly responsible for its bright future.

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УДК 330.322

THE PROBLEM OF UNSKILLED INVESTORS IN THE INVESTMENT MARKET, AS A GLOBAL PROBLEM IN THE ECONOMY. INVESTING IS LIKE GAMBLING***Boyko D.V.***

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Nowadays, it is the age of information technology, almost everything can be done without leaving home, which is why in recent years people have been beginning to learn new methods of "making money" from home, one of them is, as they call it, "investing". However, what is the problem, because nothing terrible will happen if an ordinary person opens a brokerage account, buys some stocks, and waits?

In fact, not everything is as harmless as it looks at first glance. When a person opens a brokerage account for the first time in his life and makes his first deposit, he does not know how the exchange works, what is diversification or even elementary risk control. A newly minted investor simply clicks on the shares of a conditional company and buys them, while not even knowing whether he bought them with or without leverage, he begins to wait, as everyone around him tells him, and now, having received his first profit about 10%, the person is delighted. And this is where "gambling addiction" begins, a person is inspired, he wants to earn more, small money begins to pour into the account (5 average salaries of the average resident of Russia), but he is already unlucky and he is in the red zone, and at this moment gambling addiction is already playing with full colors, loans, cars, real estate, and so on to zero. At the same time, a person does not study, does not get new experience, he does not learn to earn money, he simply loses it.

However, it is still unclear how an entire company can suffer from one person or, on the contrary, get out of debt. Of course, one person cannot, but over the past two years, more than 10 million such "investors" have been registered who cannot distinguish a stock from a bond. The simplest example is GameStop: a company that suffers losses every year made 1000% in a week, just one brave trader encouraged non-investors to buy, thus a Short squeeze occurred and all funds that "played for a fall" lost a huge amount of money, and GameStop received a rush of funds.

There is no doubt that investment is a casino, whether a qualified investor or not, as an example has shown, no technical analysis, diversification and other investor tools will help, because everything is decided by the human factor.

I conducted a study of the Tinkoff pulse social network for investors, mostly inexperienced investors and newcomers sit there, and they just teach each other investments without understanding what it is. So, the average minus of the investment portfolio out of 10 portfolios was in the region of 20 average salaries of a Russian. And money is leaving the Russian market, because 90% of negative portfolios have received their minus on many liquid foreign companies. And this has a negative impact on the Russian economy. In fact, Russian blue-chip stocks (top 10) are quite profitable.

I conducted an investigation among my generation and among the older one. The older generation believes that it is possible to make money on investments, but when asked why they do not do this, they argue that they do not know how to do it. In total, 72% believe that investments are profitable, and 28%, respectively, think that this is a financial pyramid.

The younger generation, however, thinks a little differently, almost 55% (12 people) believe that investing is not a gambling game; moreover, 80% of those who voted have a brokerage account. 45% believe that this is a gambling game and 10 people have had a bad investment experience, where they lost impressive amounts.

In conclusion, I would like to add that the money that the younger generation is losing is actually like a food chain: losing money now = not deferred money for the future = not advanced qualifications in time (unpaid additional courses) = illiteracy of the population = low level of happiness and low GDP indicators in the country = shortage of specialists. Moreover, most of the

large companies in Russia will lose investors who care about the fate of their country and the large companies in it, which in fact provide everything they need every day. After all, such a situation as with GameStop may happen more than once, but it will happen in a completely different direction and will have completely different consequences.

The problem is actually easily solvable, but only at the level of legislation: it is enough just to allow only qualified investors to bid, who will not cause chaos and know about all the subtleties. But this is not profitable for banks, because they provide brokerage services for a commission from the transaction, and this is a good amount, because the volumes are always large.

The problem will be solved only when I tell people the real problems of trading and all the risks associated with investments

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УДК 316

THE INFLUENCE OF MEDIA VIOLENCE ON YOUTH

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The article analyses the impact of media abuse on young people, the reasons for its high efficiency, and the possible impact of media violence levels on personality. The model approach to destructive influence of media abuse on young people is considered.

Today the mass media play a vital role in the life of society, performing an ideological function, influencing people's worldview, and motivating their behavior. However, morality and humanity, culture and ethics in the media have faded into the background. More and more often, scientists, sociologists, and the consumers of media products themselves speak of "the birth of a new evil of the media" – media violence.

Obviously, media violence has the greatest impact on a socially immature person who does not have sufficient life experience, a stable worldview and a clear understanding of the social expediency of normative behavior, that is, on children and adolescents. Throughout the XX-XXI centuries, this topic is one of the most pressing and urgent social problems.

But before analyzing the aspects of the media violence impact on young people and the consequences that it entails it would be logical to define what the concept of "media violence" means. The dictionary of terms of aggression by D.V. Zhmurov gives the following definition: «Media violence is an auditory, visual or other interactive depiction of scenes of cruelty and aggression» [4].

Interactivity implies the psychological relationship of the individual with virtual objects and entities. This connection can manifest itself in the form of emotions, experiences that enhance the availability of consciousness to destructive ideas. In this case, the specified relationship will be passive, that is, the role of the subject is limited to observing acts of aggression, but not to their implementation.

Television programs evoke a wide range of reactions and emotional responses in people, since each person has a unique set of psychological characteristics. Each individual viewer perceives violence in the context of the TV show genre and personal preference based on life experience. Nevertheless, researchers have documented the universality of the viewer's reaction to media violence, regardless of his individual differences, since the reaction is caused by the attraction of involuntary attention. Viewers often experience similar negative effects when viewing violent scenes in a specific context.

Sociologists have identified five key contextual components that increase viewers' susceptibility to the negative effects of media violence:

1. the perpetrator is an attractive role model;
2. violence seems justified;
3. retribution does not follow the violence (criminal acts do not cause repentance, are not condemned, are not punished);
4. the victim of violence bears minimal damage;
5. the scene of violence is perceived by the viewer as realistic.

Scientists distinguish between three levels of possible impact of media violence on a person. These levels are behavioral, affective (emotional) and cognitive. Let us take a closer look at each of these levels:

1. Behavioral Impact. The essence of this influence lies in the fact that viewing the scenes containing violence affects the behavior and general psychological state of a person. There are five main categories of behavioral effects:

- catharsis – is the most harmless or, in some cases, even useful for the viewer. The catharsis mechanism allows viewers to give a safe outlet to their aggressive feelings and emotions by watching scenes of cruelty, which allows them not to bring violence to life;
- excitement – while watching scenes of violence, the viewer experiences emotional excitement, which is partly physiological in nature;
- imitation – imitation of the behavior patterns seen on the screen;
- desensitization – with regular viewing of violent scenes, viewers become less susceptible to violence on the screen and more readily accept violence in real life;
- disinhibition – explained by the viewer's habituation to viewing scenes of violence and cruelty, justified by the situation or sanctioned by the society itself, which leads to a decrease in the effectiveness of public sanctions and norms against the commission of violations [2].

2. Affective impact. Viewing scenes of violence elicits an immediate or long-term emotional response from the recipients. The spectrum of reactions is wide enough – from the loss of self-control to nightmares. Very young children experience intense fear of threatening characters and situations, while older children are frightened not so much by images as such, but by threatening stimuli, for example, the threat of atomic war, hunger or death. This fear is to some extent stress, the consequences of which can manifest in a more mature age.

3. Cognitive impact. Viewing violent scenes affects the viewer's perception of the real world. According to research, viewers who watch TV more than others perceive this world as a more dangerous place compared to those who pay less attention to television. Scientists have

hypothesized that the constant consumption of media violence leads to an exaggerated perception of the danger in the real world.

If we concretize the consequences of media violence we can highlight the following: there is a reactivation of existing aggressive thoughts; an indifferent attitude is formed towards acts of violence against other people; violence is perceived as an acceptable way to resolve conflicts; fear of becoming a victim of violence; relaxation of internal prohibitions on the use of violence in real life.

Many experts in the psychology of aggression have tried to figure out the reason for the attractiveness of media violence for young people audience. For example, the American researcher in the field of media violence J. Cantor identified the following reasons: the desire to experience excitement; the desire to virtually experience aggression (empathy effect); ignoring restrictions (effect of the «forbidden fruit»); trying to see violence / aggression reflecting your own experience; study of the surrounding criminal world (comprehension of the role of violence in society and the area of residence of this audience); complacency [3].

The emotional component is of great importance in terms of media violence. In an effort to experience strong emotions that are not enough in real life, a young person consciously chooses media products that contain violent actions. But he does not at all think about what consequences this choice may bear.

The negative impact of media violence on young people is evidenced by the results of a sociological survey conducted in March 2016 in the city of Izhevsk. The research was carried out in the format of an online questionnaire. The experimental base was made up of students of the Udmurt State University, Izhevsk State Technical University, as well as selectively residents of various regions of Russia aged from 14 to 30 years. The purpose of the sociological study was to clarify the attitude of respondents to media violence, as well as to determine the impact it had on viewers.

Summarizing and analyzing the data obtained, it became obvious that almost half of the respondents associate their destructive psychological changes with media production. Another significant part of young people do not notice signs of trouble, but testifies that such fears arose among their friends and relatives. But almost every respondent has a negative attitude towards media violence and understands the consequences of abuse of this phenomenon.

Therefore, it becomes necessary to introduce an effective model of combating the negative impact of media violence on young people. Researchers have proposed various means of counteracting the destructive influence of violent media production. Among them is the model of L. Berkovits, which includes the following positions: the viewer will not receive an "aggressive message" if it is made clear that aggression is an atrocity; if you make it clear that aggression is punishable; if, when watching aggressive scenes, the viewer's attention is drawn to other aspects of media production (direction, acting, film aesthetics, etc.); if we do not allow the formation of identification with the aggressor in the viewer; if you convince the viewer of the unreality of the plot [1].

Also, it is necessary to improve television literacy. For example, the scientific school of media education offers special training for adolescents and young people. For this, courses on media competence have been developed, elements of media education are being integrated into school subjects; adolescents are taught to use information correctly, analyze and synthesize media information.

If we turn to the measures taken by the state, then it is worth noting the Federal Law of the Russian Federation "On the protection of children from information that is harmful to their health and development." The law includes the age classification of information products, that is, a set of rules regulating access to information that is harmful to the health and development of children.

In Russia, from September 1, 2012, age restrictions on TV were introduced for all films and TV shows. Video games developers also take the age rating system into account.

Summing up, we would like to note that media violence has an extremely negative impact on young audiences. This phenomenon is especially dangerous in media products created for children, since the forming psyche is subjected to powerful influence from the outside, forming behavioral attitudes, moral norms, worldview and value system, which will be extremely difficult to adjust later. Therefore, both on the part of the parents and on the part of the state, the most effective and strict measures should be taken to control the issue.

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УДК 303.1

SOCIO-ECONOMIC PROBLEMS IN RUSSIA*Valova A.A.*

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Economic growth has become one of the main political viewpoints in almost every country in the world. Economic growth can and should be seen as something that influences the well-being of people and, therefore, changes in the economy affect society as a whole.

The economy is a system that meets the needs of people and society by creating and using resources, most of the time those are finite. The economy can be considered one of the most important processes taking place in society among others, since it not only creates conditions for the prolongation of the human race, but also provides the very possibility of life through the production of necessary goods.

A lot of things have led to aggravation of socio-economic problems in modern Russia, among which are globalization and increased competition in the world market, the deterioration of the environmental situation, the volatility of world currencies and last but not least the aging of the population. Government policies should include measures to adapt to unfavorable trends that cannot be changed. Because at the present, most of the effort is driven towards changing those that can be changed. Sociology has tackled some of the most serious problems facing modern society: inequality, homelessness, violence, gender issues. Social issue is any deviating behavior in a disapproving direction to the extent that it exceeds the community's tolerance limit says Charles Lindbergh. Congressman.

Let us consider the main contradictions of socio-economic development facing modern Russia. It is quite reasonable to assume that all these problems are intertwined with each other and are largely caused by one another. Let's consider problems that can be identified as significant for Russia in the 21st century?

Firstly, I would like to highlight a decrease in the population and, as a result, a low birth rate. The population as of January 1, 2021 turned out to be the minimum since the beginning of 2014 - then it was 143.7 million people. After the annexation of Crimea at the beginning of 2015, the figure increased to 146.3 million people (before that, last time 146.3 million people was recorder in 2001, and the minimum was reached at the beginning of 2009 - 142.7 million people). According to the forecast of the Cabinet of Ministers, the population of Russia will decline over the next three years and by 2024 will decrease by more than 1.2 million people. Natural population growth in 2021 is negative.

As a result, a social program was created, according to which, for the birth of the first and further children, parents can receive an amount that will compensate for the costs of raising a child. The program, which stimulates the birth rate, was launched on January 1, 2007 and is still in effect today.

Also, one of the most acute problems of the modern demographic situation remains low life expectancy, as evidenced by the results of the large-scale study "The Global Burden of Disease". At the same time, the proportion of the elderly population in relation to the able-bodied population is quite large. Since the second half of the 20th century, there has been an increase in life expectancy. The development of medicine, the introduction of new types of vaccines and the use of antibiotics, the improvement of working conditions - all this influenced the growth of life expectancy - and it was fixed at the level of 67-69 years. As of 2017, the average person in Russia lives from 68 to 70 years. However, when comparing one of the European countries – Poland, a country with a developed infrastructure, a huge network of nursing homes with a high level of medical care - the indicator of life expectancy reaches 77 years.

The health of the nation is the third of several social problems. The health of a nation is determined by the level and structure of the incidence of various diseases leading to death. According to the averaged data, it makes it obvious that there are about 1.2 million people die from cardiovascular diseases in Russia, then oncology becomes the ailment from which 300 thousand people per year die. The high mortality from these diseases is largely due to the lifestyle and diet of the population and not just the low quality of health care.

The quality of life of the population is, first of all, a decent level of income and consumption, the availability of all segments of the population to public benefits. Personal incomes of the population are falling when financial economic crisis protracts, unemployment and inflation increase. According to population's expenditures exceed their incomes during last year, which makes it impossible for the majority of citizens to get access to high-quality healthcare, full-fledged leisure and recreation, and to provide a good education for their children. A number of other issues arise from this social problem, namely, socio-economic inequality and poverty, a low cultural level of the population.

In the process of economic growth, society is usually divided into "poor" and rich. On the one hand, we are witnessing an increase in stable groups of the population with a low standard of living - pensioners, recipients of social benefits, families with more 3 or more children, part of the public sector employees. On the other hand, most of the income, resources and property continues to be concentrated in the hands of a narrow segment of the population - top level entrepreneurs, major political figures. Thus, it is necessary to fight the injustice when some strata of society infringe on the rights of others. What actions can the state take? The creation of additional jobs, an increase in benefits, an increase in the financial literacy of the population - all of the above helps to reduce the level of inequity.

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LEARNING PROFESSIONAL FOREIGN LANGUAGE BY MASTER DEGREE PROGRAM STUDENTS AT TECHNICAL UNIVERSITY

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The rapid pace of development of science and technology sets high demands for graduates of technical universities, including the level of their foreign language competence. Indeed, in the context of increasingly expanding international professional contacts with foreign partners, a decent level of knowledge of a foreign language becomes both an indicator of the general culture of a young specialist and a necessary condition for a successful career. Taking into account the increased need for qualified specialists with knowledge of a foreign language, it becomes necessary to improve the quality of training of specialists in a foreign language, so that the level of proficiency in a foreign language could be sufficient for carrying out professional duties.

During their professional career, specialists need to obtain information via different sources - various industrial, commercial, economic, financial documents, advertising, personal contacts, etc.

Specialists should be participants in business communication - conferences, symposia, exhibitions, should be able to negotiate with organizers and participants of events, give presentations, carry out correspondence with partners, draw up various types of business documentation (agreement, contract, agreement, etc.). The priority goal of teaching professional foreign languages to master degree students of universities is to prepare them for communication with foreign partners in an exact sphere, to develop their professional and personal potential on the basis of the formation of their confident communicative skills.

In reality, the achievement of such level of language competence by master degree program graduates of our technical universities is difficult in practice due to the following reasons: there is an extremely little number of hours allocated for the study of professional foreign language; there is students workload with specialized disciplines; low-motivation because of skeptical attitude to the real possibility of practical usage of foreign language in the future profession.

Moreover, teaching a foreign language on a master degree program has a number of unresolved problems associated with the lack of sample work programs and the specifics of the conditions of covering the master course. The main features of the learning conditions and the formation of competencies in the magistracy are given in the article by A.S. Krylova, E.Y. Lapteva and Z.I. Aituganova [1]. The main features of the learning conditions and the formation of competencies in the magistracy include the following: a forced two-year break after completing a foreign language course at the bachelor's level, that breaks the declared principle of continuity of education; less hours of classroom studies in comparison with the bachelor's degree program; classes are held mainly in the evening; employment of students in enterprises.

At the same time, another problem is the choice of approaches, methods and ways of teaching. If this problem has been solved somehow in relation to bachelors, teaching the master degree students in a professionally oriented language is often reduced exclusively to working on the translation of scientific articles in the specialty, although it is obvious that today this type of activity is no longer relevant in its former form. The availability of modern and easily accessible electronic translators of various types nullifies the student's work, without exerting proper influence on the formation of the desired competencies. Thus, such activities as just translations of scientific articles are no longer relevant and require completely different approaches to teaching.

In such a situation, a foreign language teacher has to look for ways to increase students' motivation for their subject, encouraging them to actively study it. The process of teaching disciplines related to the study of a foreign language has a wide range of opportunities for the formation of general cultural competencies. The language training of a modern university graduate in the context of globalization acquires new significance and, accordingly, new requirements, it involves teaching the ability to find, analyze, systematize, correlate and generalize information from various sources in a foreign language, determine its cultural value and significance.

The mastering of educational material in disciplines related to the study of a foreign language should, along with the formation of purely communicative competence, contribute to the formation of universal competences, indicated in the standards of the last generation. The formation of these competencies can be facilitated by the functional analysis of the text. In the work of E.Y. Lapteva and A.S. Krylova within the framework of such an analysis, the following tasks were proposed:

- selection of information units of the text that make up the semantic core;
- the task of correlating common information units of the text, represented by different lexical and grammatical structures;
- task for decoding information presented in different ways (text, numerical, graphic, etc.);
- the task of filling in the gaps in the text with words that are appropriate in meaning (format "cloze" and "open cloze");
- a task to be performed in strict accordance with the requirements of the presentation format ("a presentation about your scientific work / an article about your scientific work", writing a summary / review / abstract / essay according to the text);
- training in the ability to visually present the required material in the required format, as an option for the development of "soft skills" [2].

The above types of tasks are aimed at developing critical thinking, the skill of analyzing and synthesizing information, presenting it in the required format. As a result, this contributes to the development of a general cultural component of universal competencies, the degree of formation of which, in turn, will contribute to a more effective process of forming general professional and professional competencies enshrined in the State Educational Standards.

When teaching foreign languages in technical universities, an emphasis should be placed not only on the general philological, but on the professional-pragmatic approach to teaching, revising the teaching methodology and making a careful selection of linguo-didactic methods that contribute to the formation of students' skills to solve professional problems determined by the requirements of the modern job market. In modern conditions, the most significant foreign language communication skills of a specialist can be considered as the following: the ability to carry out oral and written communication in the professional sphere, read original professionally-oriented texts, translate special materials, write messages (reports, plans, annotations, abstracts, etc.), understand professionally relevant audio-messages.

Motivation plays a very important role in the learning process. Motivating students to study foreign languages, it is important to show them the value of foreign language communicative competence, involving them in various extracurricular activities, such as conferences, international competitions, festivals, videoconferences, international academic exchange programs, organizing meetings with potential employers that could confirm the importance of knowledge of foreign languages by the company's employees and the willingness of employers to pay for this language competence. Financial support of specialists is an important argument in favor of learning foreign languages. Many companies now train young specialists in Russian or foreign educational institutions on special courses to improve the level of foreign language proficiency, spending significant funds on this, which can be significantly reduced by improving the quality of training foreign language specialists in universities [3].

Thus, the development and implementation of innovative techniques, educational content, the correct organization of independent work of students, the use of information technologies that contribute to increasing motivation to learn foreign languages into teaching practice, is the only way to improve the quality of students learning foreign languages in a master's program at technical universities.

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DEVELOPMENT OF TRANSPORT INFRASTRUCTURE IN THE REPUBLIC OF BASHKORTOSTAN: PROBLEMS AND SOLUTIONS

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Transport is one of the significant factors that meets the needs of the economy and the entire population in transportation, it is also a major component of the infrastructure, directly affects the dynamism and efficiency of socio-economic development of the republic. However, at present, due to the discrepancy in the level of development of the road network, the economy and the population of the country are suffering significant losses.

Let's outline some of the main transport problems:

- low level of coordination in determining tariff policy and infrastructure development of various modes of transport;
- insufficient investment in the development of the rolling stock fleet of road and rail transport;
- high proportion of the self-certified fleet of vehicles;
- insufficient level of technical readiness of a number of facilities;
- shortage of repair facilities;
- low speed of movement on highways and railways due to the unsatisfactory technical condition of sections of the road and railway network.

According to the majority of the population, the authorities are hiding behind a lack of funding and are showing inaction in solving problems with transport infrastructure, therefore, the residents themselves have taken up ways to solve some of them, they are taking measures to improve roads at their own expense and collecting the budget: filling holes, rolling asphalt and lighting roadways.

This problem requires wide publicity and the involvement of public people's control. In addition, the improvement of roads should become one of the criteria for evaluating the activities of both local and district administrations and higher-ranking bodies.

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THE PROBLEM OF DEVIANT BEHAVIOR IN ADOLESCENTS*Galieva D.I.*

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Abstract: the article reveals the content of the concept of deviant behavior as behavior deviating from generally accepted norms; highlights the main factors that negatively affect the behavior of adolescents; the methodology of correction and prevention of adolescents is given.

The problem of behavior deviation is one of the central socio-psychological problems of modern society. Analysis of scientific literature shows that a number of accesses to the study of deviation have been formed in sociology and psychology: psychoanalytic theory of Sigmund Freud; Konrad Lorenz's Imprinting Theory, frustration-aggression theory.

In sociology, deviant behavior is considered as a special social phenomenon that violates the social regime, is a deviation from generally accepted norms. In this case, aggressive behavior can also be considered deviation, since it goes beyond the scope of acceptable behavior in society. In psychology, however, such behavior is most often considered as a means of protection from a number of troubles and the possibility of realizing one's desires and goals. But all researchers agree that mass deviation under normal conditions is characteristic of people of a certain age, namely young people from 13 to 21 years old.

The age of a person from 13 to 21 years old is the most difficult stage in his growth and evolution, despite its short duration, this is the most defining period for a person's further life. This is a period of active formation of the character of a young person and his formation as a person as a whole. The complexity of this age stage, according to researchers, lies in the fact that biological and social maturation does not match in time. As a result of the change from the usual school life to other types of social activities or in situations of transition from childhood guarded by parents to independence, as well as under the influence of hormonal changes in the adolescent body, young people become the most vulnerable and compliant to the negative influences of the environment [1].

Although, according to the Ministry of Internal Affairs of the Russian Federation, in 2021, for the period from January to September, the decrease in child crime continues and it accounts for only 3.3% of the total number of crimes. There are many unreported cases of juvenile delinquency, half of which are prone to aggression and unlawful acts. Thus, a high degree of aggressiveness leading to the performing of illegal actions and deviation is an obvious problem in modern society [2].

Aggression is one of the most acute social problems of modern society. In psychology, the concepts of aggressiveness and aggression are distinguished. Aggression is understood as a specific form of destructive actions of a person, which involve the use of force in relation to other people, creature or objects. As for the form of human social behavior, aggression is a specific human behavior that contains an explicit or latent threat and harm (physical or psychological).

Among the main signs of aggressive behavior, it is customary to distinguish the following:

- A tendency to dominate others;
- Using other people to achieve their goals and desires;
- The desire for destruction;
- Causing damage to people around, creature and things;
- A tendency to display violence and cruelty.

For the effective realization of social work with deviant adolescents, it is necessary to realize the nature of this phenomenon:

1. Psychobiological factors. At the end of the 19th century, the Italian physician C. Lombroso discovered a connection between criminal behavior and certain physical traits. He believed that people are biologically predisposed to certain types of behavior.

The following groups of negatively influencing characteristics on the personality of adolescents can be distinguished:

- 1) Crisis phenomena in adolescence, which determine the difficult education of a teenager;
- 2) Mental retardation
- 3) Physical disabilities, speech defects, external unattractiveness, any defects that can negatively manifest themselves in a team of classmates and peers;
- 4) Neuropsychiatric diseases, psychopathies.

The character and temperament of a teenager is of particular importance. The type of the nervous system is innate, but a person can form the necessary socially valuable qualities in himself, i.e. develop character.

2. Pedagogical factors. Is expressed in defects in school, family or social education, at their basis - ignoring the gender, age and individual characteristics of adolescents, leading to violations of the socialization process. Alekseeva L.S. divides dysfunctional families into four categories:

1. Conflicted family. The most common among the dysfunctionals, makes up about 60% of the total [3]. In adolescents, a state of isolation, depression, or nervousness, excitability and anger is observed.

2. Immoral family. Has a direct desocializing effect on adolescents. Outwardly, the situation in these families can be quite prosperous, the standard of living is quite high, but psychological values are harmful to those around them.

3. Asocial families. Can be subdivided into criminal families, families with a predominance of physical and mental violence, and families of alcoholics.

Families with a predominance of physical and mental violence contribute to the fact that adolescents develop the belief that rudeness is the norm in relations between people. They easily fall into a state of anger, and their anger is most often directed at the weaker ones. In 30% of cases of crimes against life, adolescents commit in response to provocation [4].

3. Personal factors. This is an active and selective attitude of the individual to the preferred environment of communication; to norms and values; to family and school.

The adolescent subculture has a great influence on personality growth, especially on those adolescents whose families do not exercise the proper educational influence. According to Mudrik A.V. subculture is a set of specific socio-psychological characteristics (norms, values, tastes, etc.) that affect the lifestyle and thinking of certain nominal and real groups of people and allow them to realize and assert themselves as "we" [5]. Of particular importance is the criminal subculture, which involves adolescents in their environment.

4. Socio-economic factors. Includes social inequality, stratification of society; impoverishment of a significant part of the population, unemployment and, as a result, social tension. Due to the negative impact of socio-economic reforms, the situation of adolescents in the country is becoming more and more alarming.

Dreams of easy enrichment lead to the violation of laws, and also leads to the moral degradation of the younger generation.

Contributes to the aggravation of the crisis state of the adolescent environment and the policy aimed at the commercialization of culture, art, sports. Due to high prices, most forms of leisure are not available to adolescents.

Technologies of social work with adolescents of deviant behavior can be divided into two directions: corrective and preventive. Their implementation is based on social diagnostics (identification of forms of deviation, study of the social environment, factors contributing to the manifestation of deviation).

Correction of deviant behavior is a socio-pedagogical and psychological complex of operations aimed at regulating motivations, attitudes and behavior of an individual.

Social prevention is a conscious, purposeful activity to prevent possible social, psychological, pedagogical, legal and other problems and achieve the desired result.

The main directions of correctional work for the social prevention of deviant behavior in adolescents:

1. Formation of future life aspirations of a teenager, associated primarily with professional guidance, with the choice and development of a future profession.

2. Realization of the need for self-affirmation. It is important to normalize the relationship of a teenager in a team of classmates, to help restore his status among peers; overcome alienation from class, school; increase their importance.

3. Solving the problems of teenagers' leisure. It is necessary to develop useful interests and higher spiritual values.

4. Correction of the personality of a socially neglected teenager. It is necessary to develop a critical attitude towards former idols and the formation of new behavioral patterns and ideals in life.

The work reveals the concept of "deviant behavior". In modern conditions, it is more relevant to study deviant behavior among adolescents with a negative orientation, since such behavior destructively affects both adolescents themselves and the whole society as a whole. The work lists several factors influencing the formation of deviant behavior in adolescents: heredity, pedagogical factors, social factors, social activity of the individual himself.

Thus, there is a need to develop technologies for working with adolescents prone to deviant behavior. Social work presupposes a system of social-preventive and corrective work with such adolescents.

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PROBLEMS OF ENVIRONMENTAL SAFETY IN AVIATION SPHERE

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In our modern world one can hardly imagine life without transport infrastructure. We are all used to driving to work by cars or buses, and to travelling by train or airplane. As everybody knows, each of the types of transport has a special impact on the environment. And mostly, the impact of cars, buses and lorries is discussed. But, although the aircraft fleet is smaller than the car fleet, the impact on the atmosphere of only one airliner is equivalent to the influence of almost 8,000 cars.

For the first time environmental problems caused by aviation, started to be talked about in Chicago - on December 7, 1944. It was a date, when a document titled "Convention on International Civil Aviation" was signed. This document introduced some environmental standards into international aviation as a whole. [1]

Having done the research in the sphere of aircraft impact on the environment, it should be noted that the problem of air pollution is manifested in several aspects, which can be structured as follows:

1. Combustion products of aviation fuel are released into the air every day, and they stay in the atmosphere for up to two years. The largest number of harmful contaminants (such as hydrocarbon compounds and carbon monoxide) are released into the atmosphere exactly during the take-offs,

landings and heating of the aircraft's engine. And when a plane gets into an emergency, the aircraft must drain the remaining fuel into the air. This has an adverse affection to the environmental situation of the area where it happens.

The most dangerous factor influencing the environment is that when flying in the stratosphere (in its lower layers), the aircraft engine emits nitrogen oxides, and this leads to the oxidation of the ozone sphere, which protects our planet from radiation.

Therefore, aviation engineers are involved into the activity on how to reduce this kind of pollution. Some ways to solve problems, which arise when aviation transport affects negatively the environment have already been discussed and developed. These may include:

- the use of fuel additives;
- the use of water injection;
- the use of enriched mixtures in the combustion area;
- reduction of the working time of engines on the ground;
- reduction of the number of engines working when steering;
- engine upgrade;
- development of alternative fuels.

2. There is pollution of groundwater with petroleum products near the airports mainly due to leak of liquid fuel during refueling of aircraft, as well as due to technical malfunction of its transportation and storage.

When the aircraft takes off and lands, a certain amount of liquid and gaseous fuel settles down near the runway, accumulates in the soil and can get into the drain or aqueduct.

The most effective method of protecting groundwater from oil product pollution is to carry out preventive measures, including drilling wells to control water quality.

3. Acoustic pollution in airport areas is also a serious environmental problem, as aircrafts are sources of strong noise. Noise pollution quickly disrupts the natural balance in ecosystems. Noise pollution can disrupt space orientation of birds and animals, their communication, food search, etc. One of the most famous cases of damage that are caused by noise pollution to nature is the case when dolphins and whales throw themselves ashore, losing orientation due to the loud sounds of military sonars.

The main solution to this problem is the correct location of airports relatively to populated area. Other things that could be done are:

- the introduction of less noisy air intakes and exhaust nozzles,
- improving aerodynamic forms and configurations of aircraft engines,
- using noise absorbing and sound insulating materials and devices.

- the use of special methods of piloting during take-off and landing that lead to reduction of the noise level by 5-15 db.

4. Beyond the noise, aviation leads to electromagnetic pollution of the environment. Radars emit electromagnetic energy that flows into the environment. It can create electromagnetic fields of great voltage, posing a real danger to people.

After analyzing the information mentioned above, we can conclude that the environmental problem in aviation is very relevant today. Many countries are involved in solving this problem by controlling emissions standards. Airlines are teaming up to develop alternative fuels and upgrade engines.

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УДК 316.6:004.38

DIGITAL LIFE AS A NEW KIND OF MODERN SOCIETY***Kasian A.V., Gladkov E.A.***

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Today, gadgets have become an integral part of modern man's life. Technical progress does not stand still. One model replaces another. In the pursuit of novelties, a sense of reality disappears, and the desire to constantly use super-informative devices turns into an addiction.

So why the excessive appeal of a person to a gadget can be called an addiction? To answer this question, we should first define addiction itself. Addiction, aka addiction, is a compulsive need to perform certain actions, despite adverse medical, psychological or social consequences. Psychotherapists already identify gadget addiction as a separate disease - nomophobia. It affects adults and, even more, children with an immature psyche. This addiction is akin to drugs or alcohol, so do not run the process, and get rid of nomophobia need to be faster [1].

Various studies note both the positive impact of digital technology and the problem areas of studying online safety, the encounter with online risks. Generation "Z" is called children and adolescents born in the new century, after 2000-2004, along with the emergence of the Internet, gadgets, smartphones. These are children whose development and socialization happened and is happening along with the Internet development, in the conditions of cyber-socialization in the cyber environment.

The cyber environment can greatly transform a child's personal and mental development. The technology influence can lead to personality degradation: mental abilities decrease, real life goals are replaced by virtual ones, mental and physical health deteriorates. Instead of real meetings virtual parties become fashionable, when people gather in video chats, the desire for romantic relationships and dates is replaced by an addiction to pornography, and it affects not only single people, but also family men and women. Live communication has been superseded by correspondence in messengers and social networks, and face-to-face meetings are already seen by many as a feat. Children and adolescents who become dependent on technological environment, become withdrawn, aggressive, immersed in a virtual reality, lose interest in the world around them. Preschool children today begin to get acquainted with the digital environment very early [2]. According to the Institute of Modern Research MEDIA for 2016 43% of children under the age of 2 years have already had the experience of using a tablet in their lives, and at the age of 2 to 8 years their number is already 72% [3]. Today there is no common view on the impact of the cyber environment on the child, each parent forms his opinion on whether to give his child a phone or a tablet, or not, and if given, whether to limit the child in the ability to use these electronic devices or give him complete freedom.

Unfortunately, we can no longer completely abandon gadgets in modern life. That's why it is necessary to reduce their influence on our reality, not to damage our health. Psychologists advise to have a rest from the Internet sometimes, even to go away for a couple of days to the places where there is no connection. And at home to remove the phone out of sight. When we do something, and the smartphone is kept in the pocket or on the table, the temptation to be distracted by looking at the events of friends is much greater than if the device is lying in the next room [4]. The real reason gadgets are so alluring to us, though, is that there is too much hostility from the outside world. People are increasingly distancing themselves from each other and trying to hide from trouble in a safe virtual space.

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УДК 338.1

FACTORS SLOWING ECONOMIC DEVELOPMENT

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The main factor slowing the development of many economically developed countries is regional disparities. Differences in economic indicators between regions within countries can be quite significant, sometimes even greater than between countries. The active development of the state, the successful conduct of foreign and domestic policy is influenced by some factors that restrain these processes.

One of the factors is the discrepancy between the economic situation and the political situation in different regions of the state. Despite the developed economic policy, the economic lag of some remote regions from the state remains a serious issue to this day. This lag leads to a number of problems: economic instability, unemployment, high crime rates, low living standards and other problems. There is also the question of how regional labor markets respond to trade and technology developments, which are reflected in increased import competition in foreign markets and a decline in the cost of machinery and equipment for regions more vulnerable to automation.

The relevance of considering the directions of the economic policy of the regions is associated with the need to choose the right tactics for the economic development of the state, by analyzing the factors affecting the economy of a particular region and solving a number of problems existing on the territory of the subjects. To conduct rational policy and improve the current state of lagging regions, it is necessary to find the causes of existing problems and take measures to neutralize them, by choosing the right direction for economic development. For the stable development of the economy, it is necessary to indicate the current state of the social, political situation, the general mood of citizens in certain regions of the state.

Policies that reduce disparities and create more open and flexible markets can help regions minimize the rise in unemployment and improve the reallocation of labor and capital. Labor market policies to retrain job-losers and accelerate new job placement can also play an important role, especially in lagging regions. More open markets for products (through lower barriers to entry and greater openness to trade) can facilitate the movement of capital to regions and companies with higher returns.

In addition, improving the quality of education and training to adapt to the changing world of work (this is a key recommendation) will disproportionately benefit lagging regions with higher unemployment rates. Finally, fiscal policies aimed at narrowing gaps between regions (such as targeted fiscal support to lagging regions and programs to facilitate labor movement) can also play a role. However, these local policies must be carefully calibrated to facilitate and not to hinder adaptation.

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УДК 681.5

MODERN INNOVATIVE TECHNOLOGIES IN THE EDUCATIONAL PROCESS*Loskutova Y. V.*

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Today, technical progress does not stand still. New trends of our time make us respond with the modernization of school education. These trends give rise to new requirements for education, the main goal of which is upbringing, social and pedagogical support for the formation and development of a highly moral, responsible, competent citizen.

Modern innovative forms of education are characterized by a high communicative ability and active involvement of students in educational activities, they activate the knowledge potential, they effectively develop the communicative competence of schoolchildren. This contributes to adaptation to modern social conditions, since society needs people who quickly navigate in the modern world, independent and proactive, who are successful in their activities. At the heart of any innovation is creativity. Creative activity involves the emotional development and intellectual spheres of the individual. This is one of the main tasks of the modern educational process. In the educational process, the computer is becoming an indispensable means of development, education, and the formation of students' communicative abilities.

Educational activity at school requires the use of specific technologies that ensure this problem solution. Such technologies are innovative forms of education: role play, project method, dramatization, ICT, skype technologies. The main task is to choose methods to stimulate active cognitive activity of students, to realize the creative potential of each participant in innovative activity. The goal of the teacher is to identify the possibilities of innovative forms of education, to increase the training effectiveness, to develop students' creative abilities.

Innovative activity is one of the most accessible and effective forms of developing students' communicative competence skills, creating conditions for the individual socialization and his independence development. Project technology is a technology that stimulates the students' interests and develops a desire to learn associated with the implementation of various kinds of projects. The use of this technology makes it possible to foresee all possible forms of work in the classroom: individual, group, collective, which stimulate the independence and people's creativity.

But, does technology always have a good effect on a person? The excessive appeal of a person to a gadget can be called an addiction. Various studies note both the positive impact of digital technology and the problem areas of studying online safety, the encounter with online risks. Psychotherapists identify gadget addiction as a separate disease - nomophobia. It affects adults and, even more, children with an immature psyche. Children and adolescents who become dependent on technological environment, become withdrawn, aggressive, immersed in a virtual reality, lose interest in the world around them. Each parent forms his opinion on whether to give his child a phone or a tablet, or not, and if given, whether to limit the child in the ability to use these electronic devices or give him complete freedom.

Unfortunately, psychologists advise to have a rest from the Internet sometimes, even to go away for a couple of days to the places where there is no connection, not to damage our health. It is advisable to take the phone away. When the smartphone is kept in the pocket or on the table, the

temptation to be distracted is much greater than if the device is lying in the next room. There is a lot of hostility in the outside world. Therefore, in the virtual world, a person feels safe.

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УДК 81.272

THE CASE OF LANGUAGE POLICY: ESTONIA

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The language policy of post-communist Estonia is quite strict and explicit in relation to other countries of the post-Soviet space. It can be seen as an attempt by the Estonian state to revise and renormalize the problematic language situation that was a legacy of Soviet history. Language policy literally became the main cornerstone in the change and transformation of Estonian society that began in 1988 (Siiner 2006). Starting with the period of «glasnost» in the USSR, which allowed Estonians to openly express their concerns about their national integrity, the Popular Front emerged, which vehemently opposed the further influx of Russian-speaking population, as well as for the Estonian language to become the official language of Estonia (Marshall 2009). On January 18, 1989, the First Language Act was passed, which established and designated Estonian as the only official language in Estonia. Such a law was a fairly understandable reaction to the "catastrophic" growth of Russian monolingualism in Soviet Estonia, as it was seen by native Estonians (Siiner 2006). Such a policy of Estonia is characterized as a policy of nation-building of the state as "nationalization" through the promotion of the political or cultural interests of the main nation of the state (Brubaker 1998). The Estonian language was perceived by Estonians as a kind of symbolic border between two cultures: between Russian and Estonian (2006). Thus, they replaced the non-existent political border between Russia and Estonia. The adoption of the Language Law was followed by the promotion and even imposition of the Estonian language on non-Estonian speakers, which was established as one of the key goals of Estonia's integration policy (Integration into Estonian society 2000-2007, 2008-2014, 2014-2020). In addition, more than 400 laws, legal acts and regulations have been adopted to regulate the public use and status of the Estonian language (Siiner 2006). All this was done in order to ensure the functioning of the Estonian language as the state language in all spheres of life for the preservation of the Estonian language "at all times" (Pawłusz 2017, see Estonian Language Foundation 2011).

The problem with such a strict language policy in Estonia is that after the collapse of the Soviet Union, the Russian-speaking population had to pay for years of forced bilingualism. The only minority that enjoyed state support in their native language was the Russian-speaking minority, but even so, it was not perceived by Estonians as a real national minority. The laws adopted at that time

devalued the idea of protecting national minorities in Estonia. All this was a stillborn project, since the sociolinguistic conditions that took place made the enforcement of laws difficult, if not impossible (Siiner 2006). Since language integration in Estonia was often focused on the percentage of Russian-speaking non-citizens who passed the Estonian language exams, this policy became a problem. In order to master the Estonian language, there are not enough lessons or language courses. This requires a language environment, the ability to communicate with native speakers of Estonian (Rannut 2002). The problem is that the habits of Estonians in relation to the Russian-speaking population have not disappeared. The very cross-cultural border that the Estonian language represented has remained in the minds of Estonians. The habits of interethnic communication associated with avoidance and segregation did not disappear after the collapse of the USSR. Russian culture and language were still considered the biggest threat to the survival of the Estonian language and culture, which makes the integration tasks set for the Estonian language policy seem impossible. Thus, almost all members of the Russian-speaking minority who spoke minimal or no Estonian were unable to pass the general Estonian language exam, leaving them in a legal vacuum where they were deprived of many of their basic rights (Sinner 2006). The Russian-speaking minority became increasingly marginalized in Estonian society, as their right to participate in the life of the Estonian State was based only on their language skills.

This paradigm, which is awaiting harmonization in Estonian society, raises a dilemma in which the integration of national minorities will mean that Russian speakers will need to adopt the Estonian language and way of life, while Estonians and Estonian culture should remain immune to Russian cultural practices. Such a simultaneous achievement of both goals is completely unrealistic. The goal of preserving language boundaries contradicts the very concept of integration as a mutual and dynamic process in which both linguistic units must participate and be ready to make the necessary changes. In such a contact context, languages cannot ignore each other (Laitin 2003). Such integration seems more like assimilation but not vice versa. During integration programs, the acquisition of a second language is used, especially in high school classes, and is considered as an institutional means for the integration process. Language is seen as the key to desired social mobility, and as almost the only way that members of the Russian-speaking minority can obtain Estonian citizenship. At the same time, these strategies are not fully operational in reality, since graduates of Russian-language schools in Estonia still do not have sufficient knowledge of the Estonian language (Rannut 2004). The problem is the isolation of non-Estonian students from Estonian speakers (Rannut 2002). Most Estonian and Russian-speaking children still go to different schools, just as they did in Soviet times, which is a big problem. At the same time, even when Russian-speaking parents try to send their children to Estonian-speaking institutions, this still does not bring the proper results (Rannut 2004). Also, this problem is related to the fact that there is a clear shortage of qualified teachers. The majority of the Russian-speaking population lives in the north-eastern part of Estonia with a high concentration of the Russian-speaking population (up to 90%). In these places, both Russian-speaking teachers and students lack the experience of communicating with native speakers (Sinner 2006).

Based on these results on how language policy works in Estonia, I believe that bilingualism should be the best solution to these problems related to the apparent marginalization of a third of the Estonian population. I also consider it necessary to reconsider the issue of obtaining citizenship. Russian is used by almost 90% of Estonians to some extent when communicating with Russians, while only 40% of non-Estonians use Estonian, and in most cases it serves only an occasional auxiliary role for them (2006). This shows that the introduced high symbolic value of the Estonian language counteracts its instrumental value. In general, the presence of Soviet migrants and their descendants in the Baltic States mainly continues the widespread use of the Russian language. For example, in Ukraine, the draft language policy was emphasized only after citizenship was granted to everyone who wanted it after the collapse of the USSR. Russian language, or a mixture of Russian and Ukrainian, is declared as its mother tongue in Ukraine, where a significant part of the population is Ukrainian (Polese, Wylegala 2008; Polese 2011). Russian is still widely used, to the extent that Ukraine is often described as a bilingual country, which means that most

Ukrainians speak and understand at least two languages: Russian and Ukrainian. I believe that a bilingual approach in any scenario is one of the best approaches. In the scenario of Estonia, with its historical background, even more so. This is not the right way to shut people out basing on fears and old prejudices. It can be concluded that such a normative and protective attitude to the national language as an ethnic marker makes language integration, as well as the emergence of a democratic multinational civil state, a difficult task to implement. I believe that in order to create the basis of a universal Estonian culture, at least the Estonian language, as an official language, should become a bridge between the different language groups in Estonia, and not a border between them. However, I also believe that the Russian language can also be part of the official language policy of Estonia, both because of the large number of Russian speakers, and because of how its non-acceptance brings a lot of problems to implementation of different policies.

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УДК 531.8

VEHICLE SUSPENSION MECHANISM PROGRESSIVITY

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1.1 The research relevance

Nowadays, the majority of ground transport vehicles have suspension mechanism in their constructions. One of the many purposes of the suspension is to absorb shock loads protecting the vehicle's entire structure. It is necessary for suspension to be progressive, what means the suspension should be both soft for small bumps and also stiff enough for hard shock loads.

On the example of mountain bike four-bar suspension this review presents and consider the theory behind the progression and leverage definitions in case of underlying suspension lever mechanism. For the purpose of the research a special mountain bike four-link suspension mechanism has been built and analyzed measuring kinematic indicators on computer-aided design platform SOLIDWORKS™.

The described progressivity determination method may take part in suspension design process, or in analytical vehicle suspension research. The reason for progressive suspension to become common is that it is smarter, safer and more effectively.

1.2 Leverage

In suspension mechanism the force that is applied to a wheel is being transmitted to the absorber through the lever, also called an arm or link. Practically, as it shown in equation 1, it is more accurate to determine leverage as ratio of the rear wheel axle travel (AB) to absorber travel (CD).

$$P = \frac{s_{\text{wheel}}}{s_{\text{damp}}}; \quad (1)$$

It is possible to determine leverage as swinging arm levers ratio only in the single-arm suspension mechanism, shown on fig.1.

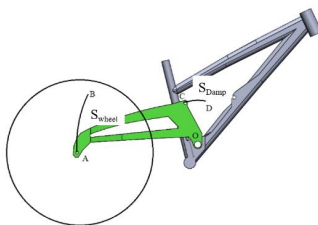


Fig. 1. Single arm suspension geometry

1.3 Progressivity

The progressivity is a variable leverage function proportional to the suspension travel. The way how progressivity forms is shown in fig. 2.

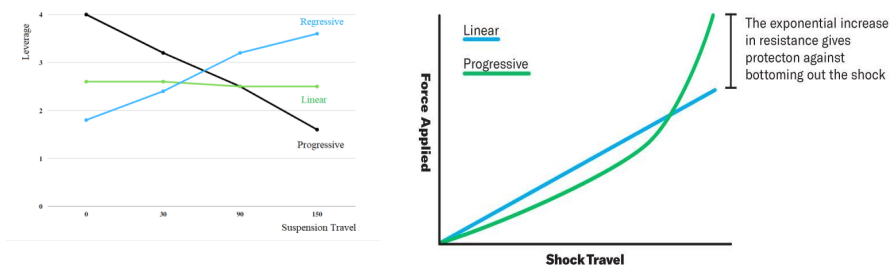


Fig. 2. The progressivity suspension graphs.

In fact, the four-link suspension mechanism is a key for any engineer to move beyond constant leverage. The leverage in a mechanism starts with high value for making it easier for small forces to effect the suspension. Then, with travel, the ratio decreases a few times. As a result, the lowered ratio requires a higher force volume to continue compressing the suspension.

2. Kinematic progressivity definition

Rising progressivity curve is based on the four bars mechanism kinematic property. In this paper we analyze the link with rear axle mount as input link and the link, connected to damper, as a driven link.

When the input link moves with constant velocity speed, the driven link rotates with acceleration. Therefore, the result of the analysis is a driven link location and velocity graph.

In the eq. 1 it can be noticed that the high leverage ratio is accompanied with low damper travel range. The reason for this occurrence is a low velocity speed of driven link on the first half of the damper travel. It is clear from fig. 3 that the ongoing motion through the suspension travel leads to the increase in link speed. It results in increasing damper movement range, in order to settle down the leverage ratio. Eventually, the suspension with a decreased leverage ratio requires higher pressure load to keep on compressing.

The described progressivity plot of driven link has shown on the fig. 3.

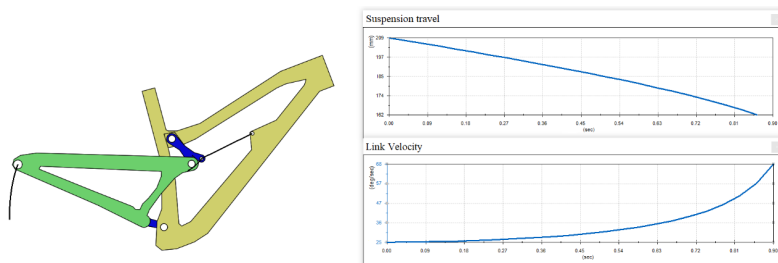


Fig. 3. Progressivity-connected curves.

Conclusion: The progressivity of the suspension is a measure of its extra shock load limit. In some professional sports, it provides more safety and better results for the racer. It is necessary to analyze and apply it for different vehicle suspension constructions. The described method enables researches to conclude about any suspension's progressivity property in a few easy steps, as the changes in driven link speed reveal the leverage ratio change of any lever suspension construction.

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УДК 165

THE PROBLEM OF PERSONALITY REPRODUCTION: METHODOLOGICAL AND TECHNICAL POSSIBILITIES

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The problem with this study is the lack of technology for preserving people's personalities at the moment. Human life is so arranged that any person begins to live without knowledge, then throughout life he collects knowledge and experience. After death, all untransferred knowledge of a person dies with him. The technology of loading consciousness will open the way to eternal life for mankind, and also allow not to lose important data.

The aim of the project is to develop a theory and technology for loading human consciousness.

The hypothesis is whether it is possible to develop a technology for loading consciousness.

To achieve the goal of the project, the following **tasks were set**:

- To draw parallels between the work of the brain;
- To Develop a theory of consciousness loading;
- Write the program for digitizing consciousness;

To solve the tasks, it was decided to use the following **methods**:

1. Collection and analysis of information about the principles of the human brain.
2. Study of literature on programming python languages;

Theoretical part

Mutual variability

Man, like many other living beings, is mutually changeable. This variability is constantly occurring from both external and internal factors.

Internal mutual variability is due to the connection of the human mind with his body. Personality affects the human body in the same way that the human body shapes the needs of the

individual. One way or another, this choice occurs in the personal zone of a person, and the choice depends on the character and will of the person himself.

External mutual variability is due to the connection of man with society. In the same way, a person's personality changes from the environment, at the same time a human being changes the environment. This happens due to the interaction of the individual with other people or because of another external factor.

Self-improvement

The brain is like an independently improving computer, which is relevant almost all its life. And in order for the brain to be productive, you need to train it. Through all its existence, humanity has developed an innumerable number of methods of how to preserve and improve your health. But, unfortunately, not all people know about it. And so many preventable health problems come out at an older age and begin to prevent a person from working productively.

In turn, computers do not increase computing power on their own, any machine in its original state becomes obsolete. But despite this, each generation of computers is becoming faster and faster. So far, people are engaged in the development of computer technology. Computers have not existed for so long and therefore there are no global problems in their work yet. However, problems with computers are brought by people themselves.

Brain and Computer Characteristics

According to various estimates, the brain of an adult male contains an average of 86.1 +/- 8.1 billion neurons and 84.6 +/- 9.8 billion non-neural cells. During mental activity, the frequency of oscillation of impulses is 14-35 Hz. When conducting an impulse between neurons, the potential varies from -60mV to +50mV. Neurons come in three types. Neural impulses in the human body pass at a speed of 250 km / s.

The amount of data passing per second can only be guessed, because this is an analog signal. With all its complexity, the brain has a big drawback – fatigue. It physically cannot work without stopping.

In turn, computing has up to 64 computing cores, using HT and SMT technologies¹, this number doubles. Processor frequencies reach 5 GHz. The voltage reaches 1.2 Volts. The structure of the processors consists of many identical transistors, which in different combinations work as separate elements with binary logic.

In fact, computers now help to do work, which can also be done by humans. However, the computer is superior to a person in this work, it processes a large amount of data faster and does not get tired.

Brain = Computer

Everything new is a well-forgotten old. The same can be said about computers, because computers partially recreate the functions of the brain. As we found out, computers do not have mutual variability, independent improvement and associative thinking, and a person, on the contrary, can have these functions to a perfect extent.

A person, like a computer, **transmits and receives information and knowledge**, but this happens in different ways. Human uses his senses, voice and ability to write. Computers communicate through the Internet and information carriers. After gaining knowledge about the required process or installing the program, a person or computer will be able to **quickly and correctly perform the task**.

Computer = brain

Computers are created for specific tasks. Let them not invent as well as the human brain, but every year humanity thanks to computers replenishes the list of possibilities of the latter.

The system acquires signs of intelligence due to its architecture. In our world, this is due to evolution, and it is impossible to list the number of changes that have occurred between a person and a living cell. In other words, the **more scenarios** the program can handle and understand them independently, **the more signs of reasonableness** it will have.

¹ Hyper-threading, Simultaneous MultiThreading

Practical part

After all of the above, it was decided to try your hand at writing a program for the Digitization of the Human Personality (DHP). The only problem is that to create such technologies, you need a lot of experience in all areas related to development. Many people are thinking about it, but there are no technical solutions right now.

Therefore, a list of required functions was simply compiled:

- Maintaining a user database;
- Message Recording;
- Convert speech to text and vice versa;
- Determining the tone of a person's voice;
- Human face recognition;
- Conversation with the selected DHP;

Database maintenance is the basis of almost any program. In my program, I used the sqlite3 libraries. The database consists of tables with data, the program makes queries to change the data inside the table, and then sqlite3 processes commands. Thus, the database maintains a table with user messages in question-answer format

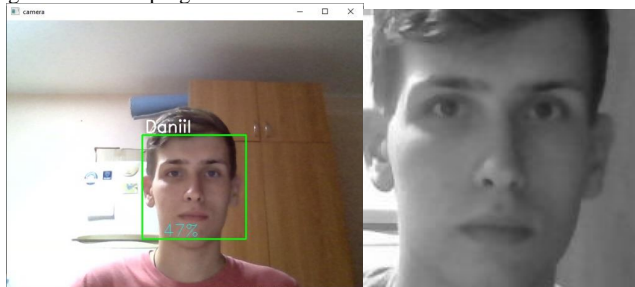
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Придумайте вопрос и ответьте на него
Говорите вопрос
Вопрос: как тебя зовут
Говорите ответ
Ответ: меня зовут столпыренко Даниил
Добавлена запись в базу данных от 2021-09-19 23:30:39.485929
ADD>msg
Придумайте вопрос и ответьте на него
Говорите вопрос
Вопрос: где ты учишься
Говорите ответ
Ответ: Я учусь в кунту-каи
Добавлена запись в базу данных от 2021-09-19 23:31:02.168033

```

For speech recognition is used through the service Google Speech To Text (GSTT), the tone of voice is determined through the analysis of the audio track in the library ffmpeg.

The program can already hear and speak. The digital vision system will allow the computer to see the person being studied and the objects they want to record. The OpenCV library was used to work with the camera. Then, a separate neural network trains photos of the face for further recognition and the program remembers the user.



Video review of the program: https://youtu.be/s2DJ_XQpVT4

This is the basis for further development of something bigger. The more scripts a program can execute, the more signs of reasonableness it will have. In the future, it is planned to write the associative parts of the program. I think of it as a set of parameters: color, shape, words in the title. Recreating a human personality in the form of a program turned out to be really difficult.

Conclusion

In conclusion, I would like to note that although not all tasks have been completed, simply because of the large amount of work to achieve them, nevertheless, progress in understanding the process of loading consciousness has occurred. The hypothesis about the possibility of loading consciousness cannot be rejected or refuted, if not today, then tomorrow this possibility will necessarily arise.

It took 2 months to write the program, and at this stage it has the basic algorithms for collecting data, and this is the basis for the further development of something more. As it was found, a person has the ability to mutual variability and independent improvement than a computer does not have. The more scripts a program can execute, the more signs of reasonableness it will have.

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УДК 316.4

DIVORCES NUMBER GROWTH

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Purpose: to study the problem of the divorces number growth in modern society.

Over the past several decades, the attitude towards divorce in the country has changed dramatically. In tsarist Russia, divorce was considered shameful and was possible only for very good reasons. The church agreed if there was public adultery with illegitimate children and a long-term imprisonment of the spouse. In the 20th century divorce became easier. Soviet ideology made its own adjustments - the divorce stamp became a kind of stigma on a person, especially in a high position. And women to the last fought for the family fearing the status of an abandoned wife.

The statistics of divorce proceedings are presented in Table 1.

Table 1.

Year	Marriages, thousand	Divorces, thousand	Marriages per 1000 population	Divorces per 1000 population
2000	897,3	627,7	6,2	4,3
2010	1215,1	639,3	8,5	4,5
2017	1049,7	611,4	7,1	4,2
2018	893	583,9	6,1	4
2019	950,2	620,7	6,5	4,2

According to the data it can be concluded that more than 50 percent of couples get divorced every year while the number of marriages is not growing.

Studies show that people usually get divorced because of infidelity, financial problems, selfishness or a lack of understanding between spouses. By the way, today women decide to divorce more often than men. According to psychologists, they are more emotional, so they take problems more seriously. Since women's rights are now more protected, they are free to choose their own destiny: they decide whether they want to live alone or with their husband.

According to a survey conducted by the All-Russian Public Opinion Research Center, among the most common reasons for divorce, Russians named poverty (33%), mutual misunderstanding (15%), unfaithfulness of one of the partners (14%), everyday problems (10%), as well as incompatibility characters and drunkenness (8% each).

At the same time, 27% of our compatriots believe that divorce is possible only when the family has actually broken up (39% in 1990), 9% are convinced that the marriage should be preserved at any cost (13% in 1990) [1].

Economic reasons have a huge impact on families. Today, when the world has entered the era of post-industrial society, a person can live in comfort in solitude. Previously, people needed a

family to survive. A person living in a pre-industrial or even industrial age could not take proper care of themselves if they were all alone. Therefore, people don't try to save their marriage just to avoid the potential financial problems that come with divorce. If a woman works, she is not afraid to be left alone without her husband's money [2].

In the 21st century, the system of human values has changed, and the attitude towards divorce proceedings has become simple for most progressive young people. This is the main problem of increasing the number of divorce proceedings in the Russian Federation today. If people of the old school still perceive the dissolution of marriage as a tragedy, then spouses of a younger age destroy families with enviable calmness. Most modern women do not depend on men, so they do not try with all their might to keep the family together.

Previously, the family model was completely different - the man earned money and provided for the family, and the woman raised the children and ran the household. Their income was much less. Now everything has changed. Women who are strong, well-earning, self-confident and do not need help are not afraid to be left without a husband.

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УДК 659.1

THE USE OF ANGLICISMS IN RUSSIAN-LANGUAGE ADVERTISING

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In the 1850s, anglicisms began to enter the Russian language rapidly and in huge quantities. In 1882 telephones appeared, in 1980-90 computers spread – all this increased the situation. And nowadays, we observe their use in every sphere of our life. Therefore, the problem of using anglicisms in Russian-language advertising is relevant today. And this problem has become a subject of study for many researchers. [1]

The use of anglicisms in marketing is caused by many factors: the demand for new terminology ("Internet", "xerox", "online", "Photoshop", "PR"), the lack of an appropriate name ("spray", "chips", "investor", "marketing") and it is trendy right now to use English words to show their level of development in everyday speech ("exclusive", "tolerant", "branding"), the prestige of foreign products ("imported goods"), the globalization of the economy.

One of the main reasons for using anglicisms in advertising is to create the impression of uniqueness ("mascara with WOW effect"), individuality ("Gillette - the best a man can get"), attracting attention by using non-traditional forms (yogurt "Biomax", center "Printexpress"). Using anglicisms for creating an international image in order to be understandable in most countries ("Gloria Jeans", "Pizza Hut") is also important for businesses. Drastic and frequent usage of anglicisms in Russian advertising entails various consequences.

Among the positive ones are to memorize and distribute words easily. The audience of customers increases and the study of a foreign language becomes more popular

The disadvantages include the loss of interest in the native language, the growth of illiteracy. Sometimes uneducated people don't know the meaning of these words and can't use them properly.

The increase of anglicisms in marketing stems from economic globalization. After all, English has increasingly covered vast geographical spaces. For example, the names of world-famous labels are most often in English, but people don't need a translation ("Subway", "Adidas", "Pampers").

The role of advertising illustrations is also important. They help to build a logical connection and perceive information adequately (the iconic "New York" coffee *cup*)

To sum up, the use of anglicisms leads to "contamination of the Russian language", but increases the scope of advertising and emotionality. Foreign words may be incomprehensible, but this does not make them less memorable, but, on the contrary, attract more attention from consumers. And this is the main function of advertising, so the use of anglicisms in it will help the company to declare itself louder, more emotionally and be remembered, which will lead to faster success.

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СЕКЦИЯ 2

ИННОВАЦИИ В НАУКЕ И СОВРЕМЕННОЕ ОБЩЕСТВО

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Секретарь: преподаватель И.Р. Гилязова

УДК: 629.7

MODIFICATIONS OF THE MC-21 AIRCRAFT

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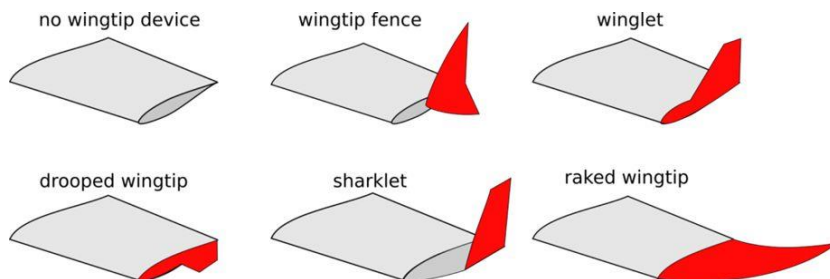
Nowadays there are a lot of types of aircraft being used in world civil aviation. Most of the air fleet are Airbuses and Boeings, no matter what company and country they belong to.

Unfortunately, our aircraft industry is not on its top now, but according to the research made, there are some interesting and promising projects. One of them is a new Russian aircraft MC-21.

Mainline aircraft of the 21st century is full name aircraft MC-21, which first flight was at 28th may 2017. The main feature is twinjet has a carbon fiber reinforced polymer wing, also another components this aircraft made by fiber-polymers too. Unfortunately, problems with supplies of composite materials postponed full-scale production until 2022.

If to compare MC-21 with aircrafts from Boeing and Airbus manufactures, a number of differences can be noticed. The first global and obvious difference is the fact that Russian aircraft hasn't got winglets.

Winglet or wingtip is a special shape of the end of a wing in a fixed-wing aircraft, or a blade in a rotary-wing aircraft, that is intended to improve the efficiency of an aircraft during the flight. In reality there are many different types of winglets, which depend on different aspects:



The winglets are of great importance as their primary purposes are:

- to increase the wing area and wing lift,
- to improve the lift-to-drag ratio,
- to reduce the lift-induced drag caused by wingtip vortices.

According to that, the following advantages can help airline companies:

- to save fuel,
- to improve flight safety,
- to increase the speed due to reduction of drag.

But on the other hand, a winglet may have some disadvantages:

- it leads to the increase of twisting of a wing,
- it increases shaking of the construction.

Studying the relevant materials, we have found information about why MC-21 doesn't have winglets. The developer of the aircraft says, that no winglets are needed in flight because of a new construction of its wing, as it was intentionally lengthened. [1]

But in our opinion, the construction of a wing of MC-21 can be improved using folding winglets, which will be moved out during take-offs and landings, increasing the lifting force.



At altitude, these winglets should be moved back to one level with the wing, which will increase the wing area. These will help to change and improve flight characteristics of the aircraft at certain stages of flight. And also, winglets could be folded down to reduce wingspan of an aircraft staying in an airport.

In comparison with the wingtips of the aircraft of the nearest competitors, this modification will allow you to adjust the angle of deflection of the winglets, and will allow you to adjust the angle of deflection of the winglets to certain weather conditions.

So that when the ends are rejected, (when they are transferred to flight mode) the aircraft did not lose its control qualities. This winglet will be equipped with mechanization on the edge, which will work synchronously with the ailerons. Why is this being done? As you know, the most effective part of the wing is its edge. When the winglet is in flight mode, the winglet will be at an angle of 100 degrees from the top of the wing, this angle does not allow the winglet to affect the controllability of the airliner and does not reduce the efficiency of the aileron. But as soon as the winglet goes into flight mode and the wing lengthens by 600 - 700 mm, and the angle of the upper part of the wing and the winglet will be 180 degrees, the controllability will be different since the winglet will be part of an elongated wing, and as a result, the effective part of the wing will change. It will be at the end of the winglet. And the efficiency of the aileron can drop by 10-15 percent. This mechanization will allow not to lose characteristics in controllability, and to improve it by about 3-5 percent.

This modification will help to add feather the wing structure, improve flight performance and make this aircraft more competitive on the world market.

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УДК 33

THE INNOVATION ROLE IN THE MODERN DEVELOPMENT OF RUSSIAN SOCIETY

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The modern world in our time does not stand still, it is constantly evolving. Today it is difficult for humanity to imagine its life without a telephone, computer, car, household appliances, exactly without innovations that have become familiar to us. Innovation is the main driving force behind economic and social development.

Innovative activity has led the world community to a new, higher development stage. Innovation processes originate in individual science branches, and end in the production field, causing progressive changes in it. In our time, innovation is not a whim, but a necessity for survival, competitiveness and continued prosperity. The innovation introduction often means for an individual the need to abandon the old and familiar, but the emergence of a new idea sometimes leads to the labor devaluation. Also, the cause of the conflict is loyalty to old values, conservatism. The innovation advantages are new intellectual jobs, the new professions emergence, the working intellectualization conditions, an increase in the education and culture level, and the disadvantages

include the destruction of such a source of economic growth as full employment. The need for innovative society development makes new demands not only on the management activities at the enterprise, its content and organization, but also on the forms and methods.

To manage the updating processes all production elements systems, innovation management is formed. The innovative economy development puts forward new requirements for personnel management. The role of employees professional training, creativity and their thinking flexibility, the employee's ability to find the right solutions in non-standard situations and develop algorithms for their implementation is increasing. The innovation processes successful development depends not on the technical achievements of individual inventors, but on a political and economic system that guarantees equal property rights based on the rule of law.

Let's highlight the most basic points of the innovation impact:

1. Impact on product quality - the emergence of completely new products that can fully meet human needs.
2. They contribute to economic growth - new sectors of the economy, a single market is being created.
3. Increase in the number of competent specialists.
4. The innovation impact on people's living standards - improves human living conditions.
5. Production costs decrease, profit increases. New technologies are being created to reduce the consumption of electricity, water, etc.
6. Affects the competitiveness of an individual or organization. A firm with an innovation will be in demand in the market until new innovations are created that have great advantages.
7. Strengthening the country's defense capability, its economic and food security, etc.
8. Influences the development and improvement of the legislative framework in the protection field of intellectual rights to the intellectual activity results and individualization means through the new documents development.
9. The development of a person as a person with the introduction of innovations leads him to an awareness of his usefulness for society, which contributes to an increase in self-esteem.

At the moment, Russia faces a rather important task of choosing a strategy for further development, despite the "Strategy for Innovative Development - 2020" adopted by the Government. This is due to the fact that at this stage Russia is not yet ready to completely switch to an innovative path of development, which requires outdated renewal industries and the development of the "lost" economy sectors. And yet, the priority program for the current authorities should be the restoration of the Russian industry, which in the future will study innovative production methods, create new, advanced technologies, products and services.

Also among the priorities of the state Russian Federation innovation policy are federal target programs: "National technological base", "Electronic development technology in the Russian Federation", "Development of civil aviation technology", "Informatization of the Russian Federation", "Dual-use technologies", "Development of industrial biotechnology", "Restructuring and Conversion of the Defense Industry".

In this regard, it is necessary to highlight the main items of expenditure associated with the innovative way of development:

1. The costs of research and development of various kinds.
2. Internal costs of research and development.

But all the same, the investment of funds in innovative activities in Russia remains at a low level, although the majority understands the importance of developing work for all enterprises in this area.

For the transition of Russia to an advanced innovative development path, the state needs to create conditions under which:

- any enterprise that explores new technologies for the economic direction growth could take a cheap long-term loan;
- a research team that creates new technologies could receive financial support for their projects implementation and the results implementation obtained in production;

- Scientists working in the main formation directions of a new technological order, and universities that train specialists of the corresponding profile, would receive the necessary funding to realize their creative and educational potential;

- every company mastering new technologies can get access to loans to carry out the necessary R&D and state-regulated markets for their products;

- the consumers interest in purchasing high-tech Russian products production is necessary;

Systemic state policy measures in the field of maintaining scientific and technological progress in Russia are reflected in Figure 1.

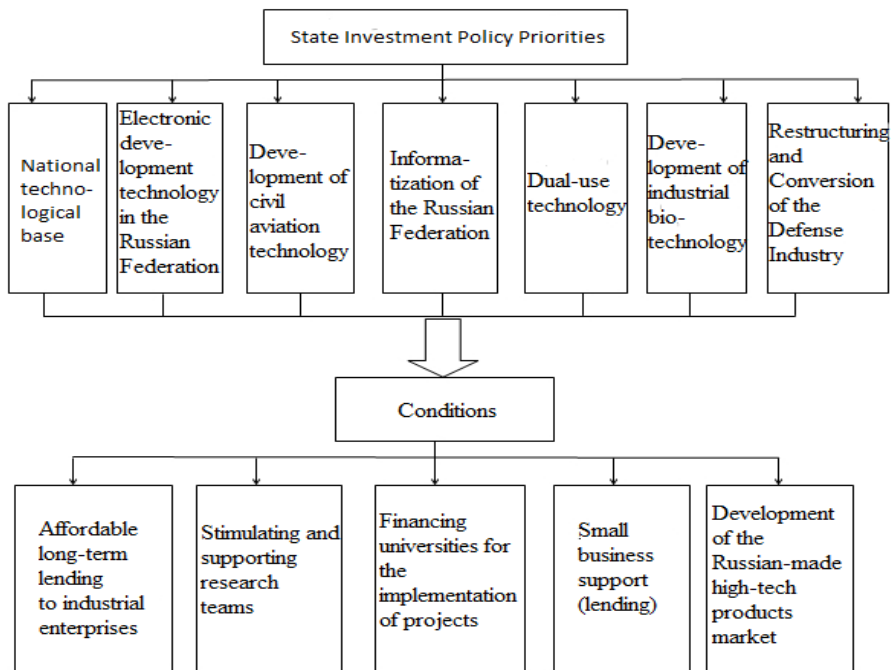


Figure 1 - Systemic state policy measures in the field of maintaining scientific and technological progress in Russia

Thus, we need systemic state policy measures that can affect the remaining scientific and technical potential, timely carry out the Russian economy structural restructuring on an advanced technological basis, fully increase its competitiveness and radically change the society attitude towards innovation. Also, an important problem is the low demand for innovations in the Russian economy and its ineffective structure: it is more profitable for enterprises to purchase finished equipment abroad than to engage in their own innovative activities. Neither the private nor the public sector show the necessary interest in the innovations implementation, therefore, production falls due to the obsolescence of technologies and processes, equipment. Thus, we get a decline of the economy due to the managers unpreparedness for innovative activities.

Based on the foregoing, it can be argued that innovations in society have a significant impact on the economy. The innovation role in modern society can hardly be overestimated. Innovations fulfill economic and social functions, cover all society aspects, affect personal issues, have positive effects and force society to change the way of life.

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УДК 621

ELECTRIC POWER SYSTEMS DEVELOPMENT STRATEGY**Akhmerov D.D.**

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This article analyzes current state of electric power systems development in Russia and suggests a possible way of its improving. According to computer's role in all kinds of systems growing, it's necessary to adapt modern energy production and transmission systems to increase their efficiency and reduce human factor in their operation.

Keywords:

Electric power systems. Power plants. Transmission lines. Automation systems. Artificial intelligence. Operational and technological management.

The main center of power system operation in Russia is located in Moscow but local operations usually provided by local operation centers that each state have in its required quantities. Each operation center requires specific personal - an operator that confirms each operation and allows lower levels of system work correctly by turning on and off transmission lines to these levels.



Figure 1. Russian unified energy system scheme.

The main problem in such way of work organization is a lack of information and high risk of human factor with operator's communications. No lower personal have direct access to system status and if they have to work with energy system, they need to call an operator to get system's status and confirm their ability to work with that part of the system.

To execute such problem we can adapt unified energy system to specific database of all power plants' and transmission lines' statuses that will be gathered by different sensors. All that data will have visual representation through easy understandable interface and all level personal will be able to observe any parameter of system part they working with. And such software is already exist, for example MasterSCADA, which is widely used in modern production lines, automatic systems, high technology buildings like smart houses and etc.

Each year the number of power substations and transmission lines grows (Figure 2,3) and with that grows the number of operators needed for their correct working. The more people used in process, the higher risk of human factor, and when we talk about electricity, such human factor can not only damage production lines and social structures but also create a risk of fatal electric shock on the accident zone

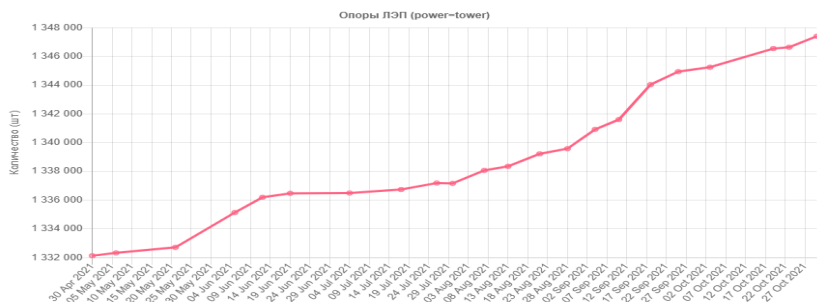


Figure 2. Growth of power towers number.

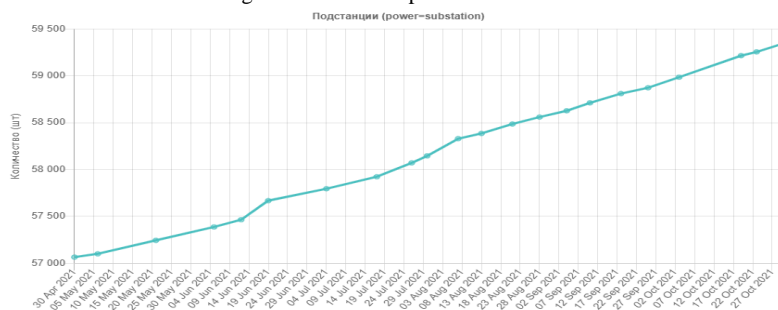


Figure 3. Growth of power substations number.

Later on, such system will integrate in artificial intelligence technology, which will allow us to reduce human factor to zero and provide higher efficiency by self-learning models of power failures, overloads, overloads, and all other working modes.

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P. 210-220

УДК 314

COVID-19 AS PART OF OUR LIFE

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In this article, I'm going to talk about a deadly virus. Covid-19 appeared in our life in 2019. First the virus appeared in China and spread rapidly around the world. Despite the fact that the virus is very young, a large number of people have already died from it. At the moment, the virus is one of the most dangerous.

Unfortunately, even if you were not sick, the virus affected the life of every person. Covid has a huge impact on the economy of every state. Due to the fact that the virus is poorly understood, the governments of states are forced to introduce lockdowns. All establishments, shopping centers, supermarkets are closed, except for pharmacies and grocery stores. The activities of small, medium-sized businesses and large industrial enterprises have been terminated or limited. [1]

The only thing that has not been affected by Covid-19 is the electric power industry. The Russian electric power system has a large amount of resources and a margin of safety in order to prevent any disruptions in one of the most important industries. All the disadvantages and advantages of our system have been identified. For example, such disadvantages as the lack of communication of some energy organizations with the population (in small towns there is no electricity at the height of the working day), and advantages such as postponing power outages overnight. The fall in demand for electricity power industry in the world since the beginning of the year was 6-8%, at the peak of quarantine - 20%, follows from the data of the International Energy Agency. The strongest demand for electricity power industry fell there, where were stricter restrictions on the operation of enterprises and the movement of people - in China, Italy, Great Britain, the USA, India. The least demand fell in countries with relatively mild quarantine measures - Denmark, Norway, Sweden. In Russia, the impact of the pandemic on the electricity power industry was not as strong as in Europe and Asia. Electricity consumption in large industrial plants has decreased and electricity consumption in residential buildings and hospitals has increased. [2]

In my opinion, this is a good experience for dealing with critical situations such as an epidemic for manufacturing industry. Although the virus has not disappeared for 2 years, humanity does not give up and continues to fight. Unfortunately, the quantity of victims from Covid-19 has reached 600 thousand people around the world. I hope that in the near future we will be able to overcome this virus.

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УДК 625.768.5

DEVICE FOR PROCESSING SIDEWALKS FROM ICE «DOLBOLED» (ISECRASHER)

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In this paper, the author presents his personal development – device for processing sidewalks from ice.

The problem of icy sidewalks is one of the most urgent in winter in the middle zone of Russia and especially in the east of the country and in its northern regions. Currently, the icing of sidewalks is facilitated by an unstable temperature regime, frequent thaws, and strong winds.

Several methods are now used to combat ice on the sidewalks: sprinkling the roadway with chemical reagents, stone chips, sand, and cutting ice with an ice pick. The use of reagents leads to the fact that with the onset of spring, chemicals enter the soil and reservoirs with melt water, some of them remain on the sidewalks [1]. Chopping off the ice with an ice pick is a slow and laborious method.

Table 1 shows the existing devices and methods of ice control, their advantages and disadvantages.

Table 1

Prototype view	Advantages	Disadvantages
Anti-ice reagent	Quickly removes ice, low price.	Dirt, during the thawing period, gets into water bodies with melt water, poisoning them, contaminating the soil.
Thorgeir Waa Method	High speed of processing the territory, environmental safety, the possibility of reuse.	The high cost of the necessary additional equipment [2].
A mixture of stone chips and sand (friction method)	High speed of processing the territory, environmental safety, the possibility of reuse.	The need to clean the road almost to asphalt, ice is not removed.
Alternative chemicals	High efficiency.	Very strong negative impact on the environment, high cost.
Ice ax	Low price, environmental safety.	Low cleaning speed, laborious to use[3].

Based on the analysis of the modern market, it was decided to create a technical device that meets the following criteria:

1) The processing speed is not less than 120 m^2 per hour (the approximate speed of processing sidewalks using an ice ax according to the standards);

2) The noise level is not higher than 100 dB (the maximum permissible noise level in the city);

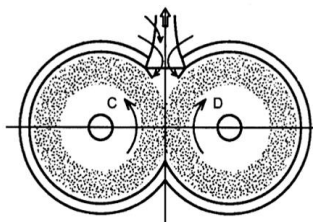
3) The price is not higher than 42,000 (the average cost of a snow blower in public utilities) [4].

After studying the sources of information (technical literature, Internet resources, opinions of professionals) about internal combustion engines and electric motors, and analyzing the results obtained, we came to the conclusion that it is better to use an internal combustion engine, because it has no connection to the length of the wire, there is no dependence battery capacity from ambient temperature.

In the process of creating the product, an original design of the device frame was developed for attaching the system of cutting elements, the mechanism for transmitting rotational motion and the engine. It provides portability and ease of use.

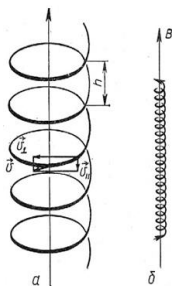
The operation of the device is based on the principle of cutting ice using multi-blade knives, for the rotation of which the torque is transmitted from the engine to the shafts of the knives through the chain. This product uses two multi-blade knives that rotate in the same plane in opposite directions (right in the D direction, left in the C direction) (see Fig. 1).

Fig. 1



When using this solution, the resultant forces acting on the frame from rotating elements are minimal. During operation, the device moves in direction B (see Fig. 2), while the rotary movement of the cutting elements occurs.

Fig. 2



The device itself is moved by a person at a speed determined empirically, depending on the degree of icing of the sidewalk. During operation, the cutting elements leave a trail in the form of a spiral up to 15 mm deep on the ice, which, together with the ice chips formed during operation, prevents pedestrians from slipping on the ice. The width of the processed strip is 360 millimeters.

As a result, from 150 to 180 m² can be processed in one hour. The final cost of this device is 27,000 rubles. The maximum noise level during engine operation according to the technical data of the manufacturer is 100 dB.

Thus, we can conclude that this development has a number of significant advantages over its counterparts; it may well become competitive in the market.

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УДК 623.618

THE ROLE ROBOTICS IN THE MILITARY

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Introduction:

The rapid development of information technologies, as well as the widespread automation of technological processes, observed in the world at the end of the XX - beginning of the XXI century, could not fail to affect the process of creating weapons of military and special equipment (WME).

The military industry has always developed with a particular speed, using all the latest scientific developments.

Main part:

Automation of combat processes, as well as the introduction of electronic computing machines into weapon control circuits have significantly improved the efficiency of AMSEM, having formed in recent decades in fundamental and technological fields of science sufficient groundwork, allowing us to talk about readiness to transition to a qualitatively new level - robotization of AMSEM.

Robotization of AMSEM is understood as a complex of interrelated organizational and military-technical measures aimed at creating and introducing unmanned (low-human) military technologies, which ensure complete or partial exclusion (minimal participation) of personnel in solving combat and support tasks.

The relevance of the use of robotic equipment in military conflicts is conditioned by:

- autonomy
- ability to act in an aggressive environment
- multifunctionality
- adaptability
- fast teachability
- low costs for operation and repair (recovery)
- saving the life and health of servicemen.

Robotization of AMSEM, including the development and creation of military robots, at the current stage is one of the promising directions for further development and improvement of means of armed combat, improvement of combat capabilities of troops (forces) in all basic spheres of military combat - aerospace, ground and sea. In particular, there are great opportunities in the application of robotic systems in the engineering forces.

At the moment, technical solutions for the development of robotic complexes are being developed in many developed countries around the world. Military robotics, primarily in the U.S., began to be seriously engaged since the late 1990s, when the Army of the Future program was adopted. A large sum of 22.5 billion dollars was allocated for the development of military robotics under this program. Another developed power was Japan, which designated robotics as one of its seven national priorities, aiming to become the world leader in robotics. The latest to enter this race a few years ago was the European Union, which adopted a multibillion-dollar military robotics program.

China has not officially announced its plans in this area, but judging by anecdotal reports on specific projects, it is working on military and other types of robotics. South Korea is also implementing a robotics development plan, the priority of which is to strategically focus on providing special equipment to individual customers - for example, robotic surveillance systems for countries in the countries in the Middle East, for example.

Work in the field of military robotics is also underway in Russia. It should be noted that some of our achievements are quite in line with the world level, but on the whole, the current level of work is insufficient, especially in the field of military robots, which is of great concern during the change of generation of armaments in the world.

The role and place of robotics complexes (RTCs) in the modern armament system of the armies of the states of the world is formed on the basis of the classification covering three main environments of special robots application and including complexes with unmanned aerial vehicles (UAV), land-based RTK (LRTK) and sea-based RTK (MRTK).

Dissimilar RTKs (capable of application in several environments, for example amphibians) are currently poorly represented in the total number of existing and developed RTKs. Researches in the field of justification of space RTK shape are being carried out.

As a rule, RTKs are structurally new models of equipment, which are used for testing basic principles of special-purpose robot control systems construction, as well as principles of using such robots in the combat order of active units.

RTKs created as a result of robotization of existing samples of crew equipment account for no more than 10% of the total number and, as a rule, are NRTKs or unmanned boats (UBMs) - a subspecies of MRTKs.

The current situation is connected, first of all, with the fact that, despite the obvious advantages of robotization of existing armament (unification of service with standard armament, ease of integration into the existing system of armament) for the development of such RTK special purpose requires the availability of appropriate accreditation, volumes of financing for revision and operation of samples, as well as complete redesign of armament, caused by dismantling a number of systems, providing the vital activity of the crew.

In terms of control systems, the vast majority of modern special-purpose RTKs (about 70%) is first-generation robots - remotely controlled robots with "hard" software control. Such robots cannot function independently in a nondeterministic environment, any deviation from predetermined conditions leads to failure and stopping, and in the most severe cases - to an accident and RTK failure. The rest of the total number of existing and developed special-purpose RTKs are second-generation robots, capable of acting autonomously in certain situations of non-deterministic environment. They can also be called "optional-autonomous" RTKs. Based on analysis of information coming from external sensors and information about their own state, "optionally-autonomous" RTK are able to recognize tactical situation and automatically adjust (adapt) to predetermined and changing conditions of application. It is obvious that adaptability of second generation RTK to changing conditions largely depends on completeness of its "knowledge base": set of program options of actions, which, as a rule, is not able to provide all possible situations of real battle. The figure shows the ratio of the three main types of special-purpose RTKs depending on the control system.

Conclusion:

In conclusion, I would like to say that the role of robotics in the modern world is very great, especially in the armed forces. Robots provide high speed and accuracy of tasks. And human resources are freed up for other operations. Based on the above, we can conclude that with the robotization of some processes, people will be able to spend more time on developing new projects.

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УДК 004.657

NEW PUBLIC SAFETY UNIT BASED ON MODERN TECHNOLOGY

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The goal of the project is to enhance public safety using the latest technology.

The main idea is to create a device which is able to scan people's faces. The question may arise of necessity for such device. The goal is to ensure the safety of people in the streets, buildings, and any public spaces. The device, of course, can be used only by security agency officers, namely Police, the Federal National Guard Troops Service, and other services of the state security agencies.

It should be noted that such technologies are not available in the ranks of the Russian public security service.

What is the point of the device? Presumably, it will be a helmet with three cameras, a screen, microphone, headphones, a processor and information storage, and also accessibility to the database. That is, the device will be able to connect to headquarters.

Cameras are needed to scan a person's face, more specifically to take photos.

Processor is needed to process the taken images according to the specified algorithms, namely: the sizes of face elements (lips, nose, ears, eye sockets, frontal bone, cheekbones, and chin).

Information storage is required to save pictures.

The screen is used by a security agency officer to monitor the device operation and establish the identity of a scanned person, and, of course, receive data demonstrating the body of their crime.

The processor will check photos with the database of people who are wanted or placed under house arrest. Thus, the processor will request the result from the database; the program will perform a check and give an answer to the operator (helmet wearer) whether the person is an offender.

If the scanned person turns out to be an offender, the security agency officer can immediately report this information to headquarters and, if necessary, call for reinforcements.

In addition to this device, there is a comparable system that will work using cameras on the streets. It is planned to synchronize the system of street cameras with the helmet and additionally use a satellite to determine the location of a person. Thus, if a street camera records that an offender walks freely along the street, this information is transmitted to the helmet, to the rapid response team which take measures in accordance with the law, specifically: in accordance with Federal Law "On Police" of 07.02.2011 No 3-FZ (as amended on 11.06.2021), Article 14. Detention, Federal Law of 03.07.2016 No 226-FZ (as amended on 01.07.2021) "On the troops of the National Guard of the Russian Federation", Article 10. Detention.

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УДК 620.93

ALTERNATIVE SOURCE OF ELECTRICAL POWER INVOLVING ELECTROMAGNETIC RADIATION FOR ELECTRON CAPTURE

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The goal of the project is to find a new way of generating electricity using the latest technology and developments.

The main idea is to create an alternative source of electrical power, more specifically an installation capable of generating electricity from the air.

Of course, in the modern world there are many ways of getting electricity, but the present method is not conventional like the others. This idea will be relevant for powering some devices in

challenging situations, like powering devices that should not stop working when the power is cut off, for example, in Medical Centers, ventilation systems and other devices vital for people.

What is the main point of this idea? It will be a device capable of pulling electrons out of air using electromagnetic reaction and chemical compounds of substances (metals).

It is planned to base the device on various silver compounds, the most active oxidizing agents, namely: platinum hexafluoride, silver (II) fluoride, cationic form Ag^{2+} .

Silver, as the most conductive material, will be taken as the basis for "pathways of transferring trapped electrons to the accumulator, where the electrons will be stored." A number of silver plates will be used for this purpose.

Thus, we will capture electrons, more specifically, redirect them to the device using electromagnetic reactions, then substances that have an electron deficiency (silver and its compounds with other chemical substances, the most active oxidizing agents) make a move. Therefore, we will be able to "collect electrons" from air. Oxidizing agents will help storing these electrons in the device.

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УДК 629.73

SUPERSONIC COMMERCIAL AIRPLANES' CONCEIVABLE FUTURE

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Humanity entered the "supersonic era" on October 14, 1947, the day when American test pilot Chai Yeager on the Bell X-1 (experimental aircraft) reached a speed of $M = 1.06$. The next important date in the history of aviation can be considered when the world's first supersonic passenger aircraft Tu-144 took to the air.

And so, some decades down the line we revert to supersonic passenger aircraft (SST). Is there an opportunity to renew air vehicle or will this technology not be able to be fully used for a long time? Will engineers be able to solve the most significant problems of the SST or will international aviation standards be changed? Let's try to understand a little in this article and put forward some suggestions.

As you know, the elephant in the room for the SST is a high noise floor, arising during the changeover on supersonic mode. The main restrictions are put forward by the international aviation standards ICAO and GOST 22283-2014, according to which the maximum loudness level at a single exposure should be in the range of 65- 75 decibels, depending on the time of day [1]. And as Kirill Syalo notes: "The task is to reduce the noise to 68-62 decibels, and most importantly - to reduce the band in which the sonic boom is felt. This is the main task for us" [2]. It's no secret that the main "noise producer" is the engine, and it is worth starting with it. For engineers, the task is to develop an engine capable of operating at supersonic speed for a long time, which at the same time will fit into the norms.

The next problem is sonic boom (the impact of a shock wave on objects produced by air impact wave from an aircraft flying at supersonic speed). It is impossible to completely get rid of this effect according to laws of physics. The only way to solve the sound shock problem is to artificially limit

flight modes. It is known that the sine of the Mach cone angle depends on the speed of sound at a given temperature (can be considered a constant value) and the speed of movement of a body in a given medium. Accordingly, if we limit the speed of movement of the body, the angle will decrease. The impact wave at the speed of the $M = 1.1$ at a cruising altitude of 10 km will be significantly less than at a speed of $M = 2.2$. In the first case, the impact wave may not reach the Earth's surface at all.

Another not unimportant problem for aviation is air resistance and, as a result, heating of the shell. One of the solutions is to increase the flight altitude to 15-18 km, where the atmosphere is less dense. Or use composite materials, for example, carbon fiber-based polymers, which are lighter than aluminum and have a higher modulus of strength than steel. As Kirill Sypalo says: "The bet is not even on materials, but on the synergy of materials, technologies and structures that will provide the specified qualities" [2]. This means not only the use of metal composite structures, but the use of a grid structure with an uneven grid cell: where the load is greater, the grid is thicker, and where less is rare. There are already patents for this development: "Construction of a cellular filler panel" № 173383 and "Cellular structure and device based on it" RU2668288C1 [3].

Also, do not forget about the aerodynamic configuration, which provides flight stability, landing on normal runways and high flight speed. It is received wisdom that the Tu-144 and Concorde used acute delta wing which reduced the air drag and the sonic boom. In the concept of the new SST, it is proposed to use a wing in the form of a double transverse V, which has a positive effect on aerodynamics and reduces drag (Fig.1).



Figure 1. Variant of aerodynamic configuration

In addition, aviation is always struggling and will always struggle with weight. For the new SST, it is proposed to use liquid crystal screens both in the cockpit and instead of pax cabin window.

The above idea has several advantages:

1. Strengthening of the hull tube, since the fuselage will be solid.
2. Improved visibility during boarding and passenger comfort, due to a large number of external cameras projecting images onto LCD screens.
3. Weight reduction, because there will be no hydraulic drives for the nose of the aircraft and a smaller wall thickness.

The concept of the new SST looks this way: (Fig. 2)

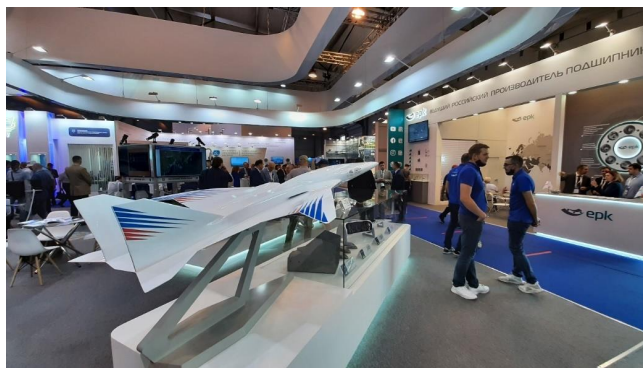


Figure 2. The concept made by Central Institute of Aerohydrodynamics

1. Double transverse V-shaped wing.
2. Airframe made of composite materials of cellular structure.
3. Full or partial automation.
4. One-piece lightweight fuselage with LCD screens.
5. The flight altitude is 15-17 km [4].

Summing up, it remains to add that the design of a supersonic passenger aircraft is a multifaceted problem that requires an integrated approach. And as the greatest Soviet aircraft designer A.N. Tupolev said: "Aviation is a battering-ram that breaks through a wall of sciences' ignorance." This statement can be safely applied to the design of the SST, because it will be a giant breaking through for our entire science and industry.

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УДК 004.946

A STEP INTO THE FUTURE: VIRTUAL REALITY TECHNOLOGIES

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Introduction:

Many scientists and science fiction writers thought about how they could plunge into another reality using various devices. It sounds like an ordinary childhood fantasy, but, in fact, it has become reality for more than half a century.

The development of science and technology has given us such miracles of innovation as VR, AR, XR and MR technologies. All three of these technologies are associated with the ability to interact with reality.

Main part:

Why is it important to differentiate concepts?

There are many approaches to simulating reality, while the concepts can be very different from each other. You cannot call each technology VR, since the degree of human immersion in artificial reality differs, and the devices for this are different.

When we talk about VR, XR, AR, MR we mean different things. Thus, a large number of definitions are a real necessity, not a gimmick of marketers. Let me tell you about each of them.

What is VR?

Virtual reality (VR, English virtual reality, VR, artificial reality) is a world created by technical means, transmitted to a person through his sensations: vision, hearing, touch and others. Virtual reality is based on the creation of computer sounds and images. It completely separates the user from real reality (RR) using a VR headset, headphones, joysticks and replaces it with a simulation. This technology allows us to plunge into a completely different world, where we can feel like a hero of a movie or book. Therefore, this technology is actively used in the creation of games, in scientific experiments in order to check some conditions and in cinematography. This technology has been developing to this day. VR developers are working on the possibility of maximum immersion in the "artificial world". Already now, in addition to immersion through sight (VR - glasses, VR-helmet), we have the ability to manipulate objects of this world using various joysticks that allow us to feel this world.

What is AR?

Augmented reality (AR— "augmented reality") is the result of introducing any sensory data into the visual field in order to supplement information about the environment and change the perception of the environment. Unlike VR technology, this concept has existed not so long ago. The key difference from virtual reality is that we do not completely immerse ourselves in another world, but only complement our real reality. The technology has great prospects in the development of many areas: for example, using AR, we can try on shoes on ourselves, even without having them with us. Architects, on the other hand, can competently draw up a design in a room without moving furniture in reality. The use of AR for educational and informational purposes has also become popular. In many museums, it is possible to obtain additional information about an object simply by pointing the camera at the object.

Moreover, this technology is technically simpler than VR. It takes less memory on computers, plus this technology is already built into many phones, which makes it possible to get by with the purchase of various additional devices.

What is MR?

Mixed reality (MR), sometimes referred to as hybrid reality (encompassing augmented reality and augmented virtuality), is a consequence of combining real and virtual worlds to create new environments and visualizations where physical and digital objects coexist and interact in real time ... It exists not only in real or virtual form, but as a mixture of real and virtual reality, it covers augmented reality and augmented virtuality.

The task of MR is to combine virtual and ordinary reality to such an extent that a person cannot distinguish one from the other. To do this, the computer must be able to "draw" 3D objects into the real world, recognize objects and analyze objects in the image.

In AR, sketchiness is enough, the main thing is a practical result. The task of MR is deeper - virtual reality should ideally fit into the real one in order for a person to fully immerse themselves in it. All senses (sight, hearing, etc.) must be imitated, objects must have a plausible pattern of behavior, they must be interactive.

Mixed reality should be multi-layered, that is, the real and virtual worlds are processed by the computer at the same time, while the processor also creates a third, mixed world. Real and artificial objects must interact with each other.

Mixed reality can be used as you like. With MR, you can do literally anything, both entertainment and practical tasks. Already, MR is used for business (task management) and for

education (simulation of phenomena and objects). In addition, there are successful cases of using MR for training military personnel.

Mixed reality is used in practice and for medical purposes. During complex surgical operations, the doctor sometimes has to visualize biological objects or phenomena, and MR helps with this. In addition, medical personnel need to constantly interact with each other, and MR speeds up this process and makes it more visible, as a result of which work efficiency increases.

What is XR?

Probably the most confusing acronym used to refer to virtual realities. The confusion surrounding the XR concept has arisen due to the fact that the term has been used in scientific papers and marketers in different ways.

Very often the term “XR” is used to refer to AR, VR or MR. Thus, marketers are trying to intrigue buyers by the fact that their device uses a new technology. For example, this was the case with the iPhone - Apple promised XR capabilities for the smartphone camera, while the XR turned out to be a regular augmented reality (AR).

Another way to use the XR notation is to combine all such technologies into one term. In this case, XR can be VR, MR, AR, or CR. The term is used because there are many similarities between technologies and researchers often deal with the problems of each of them.

In addition, XR could also mean something like an improved MR. There is a concept that implies a partial combination of the virtual and real worlds. Some XR developments, for example, allow the user to take objects from the real world and copy them to the virtual one, and vice versa.

XR Usage Examples

It all depends on the context in which the term is used. Most likely, XR will mean any other virtual reality technology, which means it makes no sense to talk about specific examples - any from VR, AR or MR will do.

On the other hand, some marketers advocate the uniqueness of the XR term. In this case, XR means a combination of AR and IoT - the Internet of Things. Devices from the real world affect the virtual one, and vice versa. In this case, XR is quite unique: it can be used in education, industry and manufacturing, in scientific research.

Conclusion:

Virtual reality technologies really became a breakthrough of the 21st century. Moreover, these technologies are still continuing their development path, and I am sure that this progress will provide a huge breakthrough in the field of scientific discoveries, and in the daily life of people.

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УДК 004.8

ARTIFICAIL INTELLIGENCE

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Introduction:

The level of development of the technical and scientific area depends on the level of development of the humanity. Society has long had an interest in the study of something complex and inexplicable, as well as in the discovery or creation of something new. Along with human progress, scientific progress grew, followed by technical progress. From the very first and simplest

inventions and discoveries, humanity today has reached truly incredible innovations. One of these discoveries was the creation of artificial intelligence and robots working on it.

Main part:

The science of artificial intelligence dates back to the middle of the 20th century. Since that time, in many research laboratories, scientists have been working on creating computers that have the ability to think at the same level as humans. At that time, the prerequisites for the emergence of artificial intelligence already existed. Psychologists have created a model of the human brain and studied the processes of thinking. Scientists-mathematicians created the theory of algorithms, which became the foundation of the mathematical theory of computation, knowledge about the world was ordered and structured, the problems of optimal calculations were solved and the very first computers were created. New machines were able to perform calculations much faster than humans, so scientists thought about the possibility of creating computers that reached the level of human development.

Today, the development of artificial intelligence is developing in two directions: neurocybernetics and black box cybernetics. One of the areas - neurocybernetics, or artificial intelligence, is based on modeling the work of the human brain using artificial intelligence systems known as neural networks or neural networks. The second direction of artificial intelligence - black box cybernetics, or machine intelligence, is engaged in the search and development of algorithms for effectively solving intellectual problems using existing computer models. For this direction, the main thing is the principle of its operation: the reaction of a "thinking" machine to input influences should be the same as that of a human brain.

The use of artificial intelligence in work allows not only to automate any process, but also to customize it in accordance with the specific task of a person, department or production. The work of artificial intelligence becomes more efficient through continuous learning - the more the neural network recognizes details and needs, the better it functions.

Today, artificial intelligence is used in almost all areas of life:

- Finance: algorithmic trading, market research and data mining, personal finance management, financial portfolio management;
- Heavy industry: the use of robots in work that is considered dangerous to humans, in routine work, etc.;
- Medicine: artificial intelligence for making medical diagnostics decisions, interpreting medical images, robots for nursing and elderly care, creating treatment plans, etc.;
- Human resource management and recruiting: artificial intelligence for viewing candidates' resumes, for predicting candidate success, for creating chatbots for repetitive tasks;
- Music: virtual composers and more;

Artificial intelligence is no longer science fiction, computers recognize faces, predict traffic situations, and warn of health problems. But despite impressive projects proving that the integration of artificial intelligence makes life more convenient and safer, the future of artificial intelligence does not come soon. Already in the near future, artificial intelligence will cover even more spheres of human life. Thanks to him, the lives of many people will become better.

Future Artificial Intelligence development areas:

- Cybernetics: The use of computers and robotic devices maintain and improve the abilities of the body and brain. Some developments will be produced for comfort, while others - for the restoration of important functions of the human body. For example, bionic prostheses for amputees.
- Climate and environment: combining different mathematical models with the help of artificial intelligence. It will increase the accuracy of forecasting and expand the possibilities. For example, you can look at the picture of climate change on the European coast of the Atlantic Ocean for several years to come.
- Communication: Building and developing robots capable of recognizing human emotions, human speech and actions.

- Helping people: in the future, a person will have the opportunity to have a robot assistant next to him, which will be able to help him in his daily activities. It will especially help the older generation.

But despite the many advantages of artificial intelligence, it has serious drawbacks that hinder its development. Some of the biggest disadvantages of the artificial intelligence are:

- Loss of incentive to be creative: Computers are ubiquitous in the arts and appear to be pushing people out of the arts.

- Artificial Intelligence Accidents: Modern machines and programs have the ability to adapt to changing external factors, that is, to learn. Machines with such a degree of adaptability and reliability will be developed very soon, which will allow a person not to interfere in the decision-making process. This can lead to the fact that people are unable to adequately act in the event of an emergency.

- Artificial Intelligence Training: Learning is possible only on the basis of data, it is not possible in other ways. This means that any inaccuracies in the data will affect the results. And new levels of forecasting or analysis must be added separately.

Conclusion:

Artificial intelligence is one of the most significant discoveries for modern society, which will entail many positive changes in people's lives. The development of artificial intelligence has serious drawbacks, but if a person takes control of them, then artificial intelligence will not pose any danger to society but it will make the every person's life better.

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УДК 620.98

THE PROBLEM OF TECHNICAL SCIENCES IN THE FIELD OF ELECTRICITY GENERATION IN A CLUSTER OF CARBON-FREE ENERGY.

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At the moment, the most common raw material for generating electricity is the carbonaceous type of raw material. According to news reports, the European Union intends to reduce harmful emissions into the atmosphere to 55% by 2030. The law is part of a green deal, under which the European Union plans to take a number of economic and social measures such as phasing out oil, coal and gas in the energy sector and switching to renewable energy sources. According to experts, at the level of modern production and consumption, the explored reserves of carbonaceous raw materials will be completely depleted in the near future.

In addition, a society led by the green movement is actively demanding a reduction in the carbon footprint of energy. This desire is supported by all segments of the population in most civilized countries.

The above requirements are forcing scientists to do research in the field of electricity generation, aimed at finding alternative sources. The most promising is the development of wind turbines designed for different needs of the national economy. At the moment, the level of modern technology makes it possible to efficiently accumulate electricity only in transport and in mobile

gadgets. Based on this, it is most profitable to introduce energy sources based on carbon-free raw materials as additional sources of electricity for household power grids, for power the chargers

Thus, the implementation will reduce the carbon footprint and the total harm to the environment, which will meet the requirements of society.

This type of power system is called a distributed power system. The most common type is centralized power system. The distributed system makes it possible to reduce losses for the transmission of electricity, as well as to increase the total power supplied to the network, thereby increasing the reliability of the power system. One of the main problems in the implementation of a distributed type power system based on wind generators is the problem of placing wind generators on the consumer's territory. To charge the storage batteries, a relatively low power of the supply generator is required. This allows the development of compact wind turbines for these needs. The small size of the wind turbines will allow them to be placed directly on the roofs of apartment buildings. In the case of one-story buildings, it is advisable to use one generator supplying several houses to the charging station.

Another problem in the implementation of a distributed power system is the accumulation of excess energy during generator operation, which is especially relevant at night. When powering the battery charging stations, this problem is solved. At the same time, there is an increase in the efficiency of the power plant and a decrease in the payback period. Also, it is more profitable to power the charger only from a wind generator, since such a solution will eliminate the need to purchase additional expensive batteries, which will also reduce the harm to the environment.

Every year, the capacity of the batteries is growing, this requires an increase of the power system. Using of wind generators will solve this problem, while the efficiency of previously installed wind generators can eventually reach a maximum level.

A similar project is underway in Denmark. It is proposed to introduce a system for charging batteries of electric vehicles from a battery charged from a wind generator. This solution is more costly, since it is necessary to install expensive batteries as an intermediate circuit node. The wind generator cannot generate enough power for accelerated charging, while the above option must be implemented outside the home network of consumers. At the same time, the option proposed in the article can also be placed outside the home network, for example, in shopping centers.

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УДК 629.73

WING-IN SURFACE-EFFECTS VEHICLES' POSSIBLE OPERATIONALIZATION

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WISE aircrafts are aircrafts designed to fly at low altitude in the area of the ground effect. They have a high aerodynamic quality that exceeds the performance of aircraft. This article discusses various applications of such unusual vehicles.

The use of WISE aircrafts.

Before proceeding to the use of wing-in-surface-effect vehicles in everyday life, it is important to formulate the basic requirement for these truly unique machines - the movement of the device

above the screen should be stable and easy to control, it should independently, without the intervention of the pilot, be held at a given altitude above the screen, and the actions of the pilot should be reduced mainly to controlling the course. [1]

According to the classification of the International Maritime Organization (IMO), wing-in-surface-effect vehicles are divided into three types:

- A- WISE aircrafts that do not have the ability to detach from the ground effect,
- B- WISE aircrafts capable of flying off-screen if it's necessary,
- C- aircraft that use the ground effect only in take-off and landing modes.

Basing on the ability to fly without ground let me introduce new concept of the application - emergency rescue operations. At the moment, developments are underway in the Central design bureau for hydrofoils named after R.E.Alekseev (Fig.1). Using the main advantage of WISE vehicles compared to conventional aircraft, namely, a large payload capacity, it will be possible to reduce the number of departures. According to the Chairman of the Board of Directors of JSC "Central Design Bureau for Hydrofoils named after R. E. Alekseeva" by Georgy Antsev – the new machine will be able to take on board up to 200 tons of water, and there is a possibility of taking water from reservoirs.



When loading 200 tons of water, 1 flight of such aircraft can replace 5 Il-76 flights and 17 Be-200 flights. Nikolay Korshunov, Head of the Department of Forest Protection from Fires of the All-Russian Institute for Advanced Training of Forestry Workers estimated the cost of 1 flight hour of Il-76 and Be-200 aircraft up to 1 million rubles. The economic effect of using a rescue WISE ship is huge, with higher fire extinguishing efficiency. A one-time discharge of 200 tons of water will be much more efficient and more

profitable than 17 flights of a Be-200 aircraft.

Figure 1. The concept of a heavy emergency rescue WISE ship

The next advantage of the WISE vehicle is independence from the ground infrastructure and the ability to approach almost any type of shore. This will allow rescuers to get to the right place faster and evacuate victims of natural disasters, where the score goes by seconds. As mentioned above, such aircrafts have a higher load capacity, which will allow you to place more rescue and medical equipment, which again increases the efficiency of 1 machine and can save someone's life.

WISE ships can move not only over the water surface, but also over any flat surface, without large height differences. It doesn't matter if it's a frozen water surface, soil, sand, asphalt, and so on.

The most important thing for the use of WISE aircrafts, as for all flying devices, is the device of the take-off and landing site. This is what determines the functional capabilities of the future vehicle. The water surface is certainly acceptable, but for access to places of "civilization" during the evacuation of victims in emergency situations, it is important to be able to land, with further take-off, on highways, as well as for desert areas where there are flat areas.

Consider the possibility of using WISE ships on highways and on highways. According to GOST R 52398-2005 "Classification of highways", "motorways" include highways: having a multi-lane carriageway with a central dividing strip throughout, having no intersections at the same level with automobile, railways, tram tracks, bicycle and pedestrian paths, access to which is possible only through intersections at different levels, arranged no more than 5 km apart. The technical classification of highways is shown in (Fig.2). [3]

Since the width of the lane is standardized, in addition to the requirements for stability and ease of management, a mandatory requirement is imposed - full compliance with the existing road infrastructure, that is, the wingspan is already automatically limited by the width of the traffic lane. At this stage, there may be a problem with creating lift. A possible solution is the use of an air cushion, or a blowing system under the wing, which has already been used on WISE aircrafts designed by R.E. Alekseev.

Класс автомобильной дороги	Категория автомобильной дороги	Общее количество полос движения	Ширина полосы движения, м	Центральная разделительная полоса	Пересечения с автомобильными дорогами, велосипедными и пешеходными дорожками	Пересечения с железными дорогами и трамвайными путями	Доступ на дорогу с примыкания в одном уровне
Автомостраль	IA	4 и более	3,75	Обязательна	В разных уровнях		Не допускается
Скоростная дорога	IB	4 и более	3,75				Допускается без пересечения прямого направления
Дорога обычного типа (нескоростная дорога)	IV	4 и более I)	3,75	Обязательна	Допускаются пересечения в одном уровне со светофорным регулированием	В разных уровнях	

Figure 2. Technical classification of highways.

Also, the created aerodynamic flow should not interfere with other road users. In addition, it is necessary to ensure the longitudinal and lateral stability of the vehicle. If ensuring lateral stability is not a problem, since the lifting force increases sharply on the part of the wing approaching the ground effect and a restoring moment appears. When designing a WISE aircraft moving along a motorway, it is necessary to refer to GOST 26804-2012 "Metal road barriers of barrier type", since road barriers can be installed on highways that can interfere with take-off / landing. In addition to motorways, for take-off/ landing of light wing-in-surface-effect vehicles, roads of the usual type of category IB may be suitable, with roads connecting no more than 600 m. This distance should be taken into account at the design stage of a light wing-in-surface-effect ship. [4]

The movement of the WISE aircraft will take place in close proximity to the road surface and, accordingly, special requirements must be imposed on the coordinate meters (height, roll, airspeed, etc.) for measurement accuracy, for example, the permissible error for the angle of sliding is 0.3° [4]

The structure of the longitudinal motion control system of a light WISE ship is described in S.V.Zaitsev's dissertation "The longitudinal motion control system of a light WISE vehicle with an impact on the elevator"

The latest application of WISE aircraft is to provide year-round navigation on the rivers of Siberia and the Far East. Settlements in these regions, as a rule, are located on the banks of large rivers, which, due to difficult climatic conditions, cannot provide year-round navigation. It is difficult to overestimate the importance of year-round navigation on these rivers: transportation of goods, passengers, medical care - all this is complicated due to the climate of the region. But the use of these ships solves this problem, due to the fact that, unlike ships, they are not tied to the type of surface over which the screen effect is created. It does not matter to the WISE aircraft whether the ice is under it, or the water surface, or the ground and so on.

To sum up it must be said that using the example of this article, it was demonstrated that WISE vehicles are an effective form of transport that can be used in many areas, from cargo transportation to emergency rescue operations. Using the existing infrastructure for overclocking and entering the screen mode will allow more efficient development of the regions of the Far East and Siberia.

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УДК 37.013.78

DIGITAL EDUCATION: THE CHALLENGE FOR SOCIETY

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Innovation processes cover more and more spheres of activity in a society, including education, and digital education is of many advantages, in the case that all its pros and cons are considered.

Nowadays the pace of life is accelerating globally. Technology is rapidly creeping into lives of people. Online learning platforms are rapidly entering the world, and robotics, virtual reality, and artificial intelligence technologies are developing. Mankind is participating in the formation of a new education system – the digital education system. However, the modern community is not ready to switch to this system, the reason is the lack of training of personnel.

Digital education is education that is carried out in a networked city, through the use of online courses, electronic textbooks, distance learning, and web resources of the Education Management System (LMS).

Digital education is currently not widespread in the Russian Federation. In the document "Moscow education. Strategy 2025" [1] the concepts FLOW and GROWTH are distinguished. FLOW refers to a "personalized educational trajectory in open teams". GROWTH stands for "distributed evaluation in the talent system". There is already a hint of digital education in these names. The concepts in the proposed strategies allow students not to limit themselves to the limits of their school and use more diverse methods, which will eventually lead to their desired goals.

Since digital education in Russia is just beginning to gain momentum, it is necessary to distinguish both pros and cons in it. First, it provides an opportunity to learn at any time and in any place. Training, as a rule, takes place in a comfortable, calm, favorable environment. Materials are available 24/7. Further, a person can learn not only at home, but from any place where there is an Internet connection, remembering his or her username and password. For those, who have more free time, the program at an accelerated pace can be completed. It is important that online learning often uses a game component, which makes it particularly attractive for the younger generation. Finally, the results of training are no worse than the results of the traditional format.

Digital education is considered to be developed in school educating. Yet, the questions arises: How can teachers prepare for such drastic changes? Most importantly, they need to get acquainted with the very concept of this education, take several online courses, which help get the necessary and useful knowledge, and identify what is needed for their developments and understand how children perceive different presentation of such material [2, p. 123].

With the advent of digital education, there is a reassessment of values:

- ability to interact to gain knowledge (interactive skill);
- instead of solid memorized knowledge, independently acquired knowledge (cognitive competence);
- possession of practical skills along with theory.

Digital education has emerged in the process of integrating political, economic and cultural resources in solving local problems, that is, in the process of globalization. Globalization affects education as follows:

- international stuff is employed;
- training both at school and on the Internet;
- continuing education;
- creation of transnational educational associations between schools and universities;
- exchange of educational values across the nations.

When a school is already implementing such technologies or planning to apply them, it is worth finding out what platforms the institution is going to use. This will give time to get more fully acquainted with the information and prepare materials in advance [3, p. 89].

However, when a school does not plan to switch to digital education, nowadays it is encouraged in a community to think about how any subject will be transferred to the online course system, or to introduce elements of digital education into the daily working day with pupils. Students are more likely to pass quizzes, tests and Olympiads using a smartphone or tablet. Gamification – use of elements of game mechanics – is already used in many areas of social activity.

Thus, digital education can really bring benefits. However, it is still required to understand how it will work at school or university: 1) how much students might be interested in it, and 2) what will be the tasks and entire courses [4].

At the very beginning it will be difficult for a teacher to be burdened additionally, but in the future, it will become easier not only for him or her but also for students both in education and in future career.

In comprehensive, and secondary education, as well as in additional education, only 2.8% of learners use online training, but according to analysts' forecasts, it will increase to 6.9% by 2022 [5].

Digital education contributes to the formation of digital literacy, which means the ability to use, study and store information. Thus, this type of education allows pupils and students to get, apply, and test their knowledge in practice. Education must not only keep pace with the times, but also be ahead of them, because today's schoolchildren and tomorrow's students will become specialists in various fields, and their training must meet the needs of the labour market, thus digital education in a society is considered as essential part of it.

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УДК 621.3

REVIEW OF PUBLICATIONS ON THE TOPIC OF CHARGING STATIONS FOR ELECTRIC VEHICLES

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Currently, there is an increase in the number of cars powered by electric motors. The active spread of such electric vehicles leads to the task of creating a network of charging stations that provide fast charging. In this paper, the basic principles of operation of such chargers are considered, and the structure of a distributed control and monitoring system for such devices was proposed.

Recently, electric vehicles have become an increasingly common means of transportation, replacing cars with an internal combustion engine. This is due to various factors, including the trend towards more environmentally friendly vehicles, low electricity prices compared to fuel prices, as well as the emergence of new, more energy-efficient electric batteries that allow an electric car to travel ever longer distances. In this regard, there is a need for a special infrastructure for electric vehicles consisting of various charging stations. Unlike refueling a car with an internal combustion engine, refueling an electric car is noticeably slower, depending on the charging module and the car's battery, it takes from 7-8 hours to 60-30 minutes. Thus, there is a need to create a network of charging stations of various types. At the same time, the development of a high-power charging module, as well as specialized control and monitoring systems for the technical condition of the charging module and the charging process of an electric vehicle becomes an urgent scientific and technical task.

Depending on whether the charger is installed inside the car, chargers can be divided into:

On-Board Chargers (On-Board Chargers - OBC).

External charging stations.

OBC takes an AC power source from the mains and converts it into direct current to charge the battery, which is slow due to the limited rated power of the charger, which can be placed inside the electric vehicle. OVS allows you to make the costs of creating a charging infrastructure for electric vehicles minimal, but increases its cost and battery charging time.

OVS, as a rule, does not allow for fast charging, which can be a problem for vehicles traveling long distances, or for a long time (for example, cargo vehicles or buses).

External charging stations require additional space for installation, the cost of purchase, installation, supply of power lines and maintenance, but reduce the charging time, and therefore make the operation of an electric vehicle more convenient. External stations use direct current charging. It supplies regulated DC power directly to the batteries inside the car.

Since the DC charging equipment is installed in fixed locations with small size restrictions, its rated power can reach several hundred kilowatts. The direct current fast charging method reduces the charging time from hours to tens of minutes. Let's consider the device of an external charging station capable of charging a car with direct current.

A DC fast charging station, as a rule, includes the following functional units: an AC rectifier; a power factor correction unit (PFC), a DC-DC converter to control the amount of voltage required to charge the battery of a particular vehicle. The power supply and communication between the charger and the car are carried out through the interface of the charger connector. Figure 1 shows a simplified structure of a DC charging station.

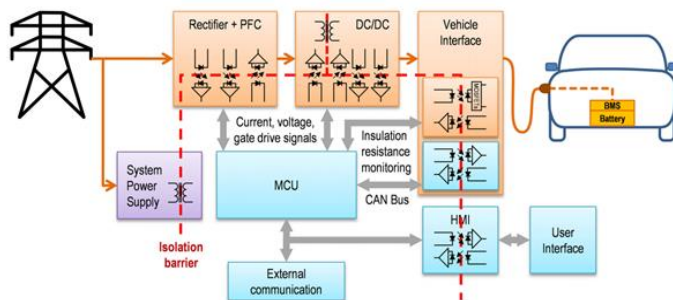


Fig. 1. Structure of the electric vehicle charging station

The structure includes the following functional units: secondary power supply, rectifier, power factor corrector, DC/DC converter, car connection interface, microcontroller, human-machine and user interface, as well as a unit for external connection. The charging station works as follows: electricity from the external power grid is supplied to the rectifier unit, the power factor corrector, where alternating current is converted into direct current, then the current passes through a DC-DC converter, forming the required voltage value. The generated voltage is supplied to the battery of the electric vehicle through a specialized interface. The operation of the entire system is controlled by a microcontroller. To provide electricity to the system, there is a separate secondary power supply unit. An additional microcontroller that allows you to control MOSFET transistors on which a voltage conversion circuit is implemented. It is worth noting that we will consider charging from a three-phase alternating current source, since for fast charging we need to work with large capacities.

Figure 2 shows the scheme of operation with a three-phase current source.

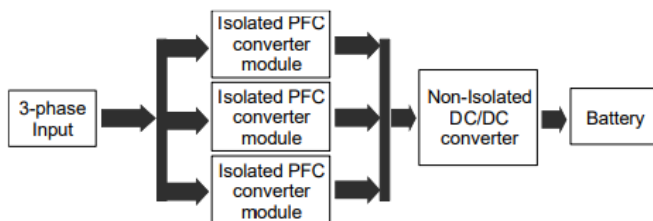


Fig. 2. Three-phase charging module

It follows from this scheme that it is necessary to embed a power corrector for each phase, this leads to the fact that a suitable microcontroller is needed to control the charger. In addition, to monitor all the necessary electricity indicators, various sensors connected to the microcontroller are also needed.

At the moment, it is advisable to create a distributed network of charging stations operating without a constantly present operator. To ensure the operability of such a system, the use of remote access, control and diagnostic technologies will be required.

The active spread of Internet technology and the development of microcontroller technology have led to the development of the Internet of Things. The Internet of Things is a network of united physical objects exchanging data, this form of information exchange between devices, often without human intervention, allows you to use many things in a new way, from household appliances to industrial sensors. In the near future, the Internet of things may get even more development, for example, many cars of various types are already being produced, with the ability to connect to the Internet. To date, this gives the driver access to various services, for example, to the navigator to

build a more optimal route, taking into account the road situation, or allows you to track the movement of cargo transport. Considering this trend, we would like to discuss the advantages of connecting charging stations for electric vehicles to the Internet.

Both the owner of the charging station and the driver of the electric car will get new opportunities, let's look at some of them. For the station owner:

- Getting data about the car (vehicle type, battery capacity, etc.)
- Information about the owner of the car
- The amount of kW spent on charging
- Electricity consumption by the charging station
- Monitoring the status of the charging station (for timely troubleshooting)

For the car driver:

- Charging time
- The amount of electricity needed to fully charge
- Car battery status
- The ability to track the location of charging stations and build a route, taking into account the power reserve and charging stations along the way

To connect the station to the Internet, it is necessary to use special microcontrollers or modules, they can be integrated into the charging station system (Fig. 3).

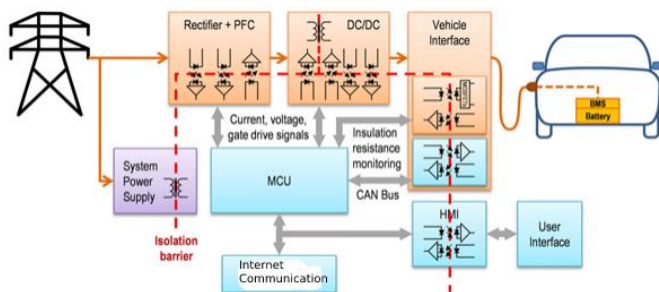


Fig.3. Network connection diagram

Thus, we have the opportunity, firstly, to receive data from the microcontroller (receiving basic information about the charging process), and secondly, to monitor the operation and charging process, interrupt it in case of emergency. Thanks to this, you can monitor the status of the charging station, which increases its autonomy. Such a system can be upgraded if separate sensors are connected to a microcontroller connected to the Internet to monitor the state of the external environment. For example, if a charging station receives electricity from solar panels, and the weather becomes unusable, the lighting sensors will transmit a signal to the microcontroller and the station may temporarily close and notify everyone who wants to refuel so that they have time to choose another route. When there is a network of such “smart” electric gas stations, they can respond in a timely and coordinated manner to various situations, while such stations provide us with complete information about their work, which allows us to make different decisions related to their further operation.

The infrastructure of automotive power plants is the key to the widespread use of electric vehicles. Electric vehicle charging stations, especially those with fast DC charging, use sophisticated power supply systems to deliver large amounts of energy to the vehicle's battery over a short period of time. This system can be connected to the Internet, thanks to the connection of special microcontrollers. Based on the data on the operation of our system received from the microcontroller and the connection of various peripheral devices, we can receive new data on the operation of the charging station, using special software, you can link the operation of the charging

station with various services. Thus, the use of “Internet of things” technology in the field of charging stations provides a number of advantages that have been described above.

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ELECTRIC VEHICLE CHARGING INFRASTRUCTURE BASED ON RENEWABLE ENERGY

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The significant increase in the use of electric vehicles (EV's) has led to in a remarkable rise in demand for electric energy across the globe. EV's are great alternatives to commonly used conventional vehicles. EV's have the ability to reduce climate effect and pollutant emissions significantly, producing zero carbon emissions. The global EV market has grown significantly. And the electric transport market of Russia also continues to grow and develop at an accelerated rate. The Government of the Russian Federation has issued a disposal in which the Concept was approved that set the tasks for the development of the domestic infrastructure of electric transport [1]. According to these tasks the key targets for the implementation of the first stage of the Concept are:

- production of at least 25 thousand electric vehicles;
- commissioning of at least 9.4 thousand charging stations, of which at least 2.9 thousand are fast charging stations.

The issue of powering charging stations, as we will see later, is important and relevant at the current moment. Along with the issue of improving the conditions for modernization and implementation the renewable energy systems. According to the statement of Russian Deputy Prime Minister Alexander Novak, Russia plans to increase the share of renewable energy sources in the country's energy balance by 10 times - from the current 1% to 10% in 2040 [2]. This growth will occur mainly due to a strong reduction in the share of coal energy generation from the current 15% to 7%. The existing electricity network system, is mainly powered up by various types of fossil fuels, that it adversely affects the environment and the world ecological system. And the rapid growth of EV charging stations will only exacerbate the current ecological predicament and will accelerate the rate of contamination, if they continue to be powered by such grid. A lot of energy supplying companies, research centers started thinking about reducing the pressure on electricity grid. And therefore it is a great opportunity to integrate renewable energy infrastructure into developing charging infrastructure for electric vehicles, simultaneously improving the nation's electricity grid system.

To answer the question on how exactly the EV charging stations are affecting the grid, let's consider the grid impact analysis of EV charging stations done by National Renewable Energy Laboratory [3]. The analysis was conducted in California and performed on two distribution models: the IEEE 34- node system and California distribution feeder model, with charging stations

connected to various locations in the system. Four case studies have been carried out, with the base case presenting a case without any charging stations. Case 1, Case 2, and Case 3 are representing good, mediocre, and worst locations, respectively. And it was found that connecting charging stations to worst or other locations causes major voltage dips and generally increases voltage instability. Location 1 (good location) has better capability to handle EV charging than locations 2 (mediocre location) and 3 (worst location). But even Location 1 can't handle the spiky heavy and charging loads: the voltages decrease to less than 0.95 p.u.

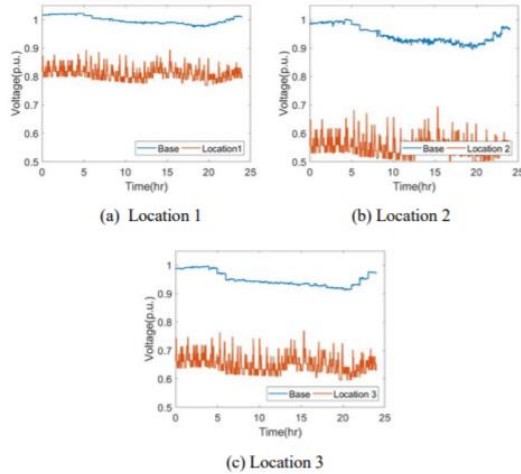


Figure 1. Voltage profiles of 3 charging station locations.

It's worth mentioning that one of the key factors we should take into account is time, when the demand of EV charging occurs. Various studies showed that it really matters when the consumption occurs, even if there's overall increase in it. And smart charging programs were developed. One of the solutions is a system in which EV's don't charge until a signal from a grid is given, when it's ready to power the stations. But most of these solutions put to some extent a time limit, that restrict the consumers. And one of the benefits of renewable energy-based charging infrastructure is that it won't limit the end users as much as those smart systems mentioned before.

However, in order to achieve sustainable energy supplying and balancing energy storage infrastructure must be developed, as storage systems can provide electricity in low power generation.

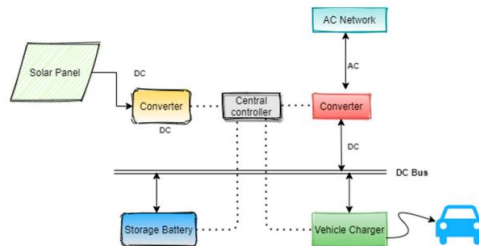


Figure 2. EV charging scheme with Solar PV Charger.

The main reason behind storage system implementation is that though wind power and solar power plants are more environmentally friendly compared to fossil-fueled power stations [4] and have a great potential to produce electricity, their electricity output isn't that reliable. And using storage systems to stabilize the grid power isn't a new technology. Let's see, for example, how well-developed residential battery storage infrastructure in Europe. According to SolarPower Europe's "European Market Outlook on Residential Battery Storage" published October 2020 [5], the market researched showed strong growth for batteries in Europe. In only 2019, a total of 745 MWh battery capacity from 96,000 systems was installed, representing a 57% year-on-year growth.

Thus we draw the conclusion that EV charging stations have detrimental impact on voltage stability, produces power losses, though, EV's are one of the best alternative to reduce the emissions at the current moment. And that's why renewable energy sources are some of the most effective ecological solutions to meet consumer's demand. And the developed storage system infrastructure requirement isn't the major challenge as we saw earlier. The major challenges remain the same: constantly changing load characteristics of EV's and uncertainties of the renewable sources.

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УДК 620.92

IMPLEMENTATION OF THE SMART GRID INTELLIGENT NETWORK

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Energy sustainability and environmental preservation have become worldwide concerns with the many climate change manifestations and the continually increasing energy demand. As cities and nations become more technologically advanced, electricity consumption rises to levels that may no longer be manageable if left unattended. The Smart Grid offers an answer to the shift to more sustainable technologies such as distributed generation and microgrids [1].

Smart Grid is an automated software package that allows, based on information received from all system objects and intermediate network elements, to correctly distribute all available energy between consumers, while ensuring the power grid stability in terms of voltage assessment. Also, this concept is relevant in connection with the expansion of the "green" energy market in Russia. The renewable energy sources using, along with the advantages, has a number of disadvantages, one of which is the inconsistent electricity supply by wind and solar power plants. Smart power supply networks solve this problem by providing an electrical energy two-way flow and information between power plants and consumers.

Smart power grids are equipped with control systems and emergency control systems that allow you to quickly respond to emergencies and restore the networks operability. An array of sensors monitors electrical parameters such as voltage and current, as well as the critical components condition. These measurements ensure the stable functioning of the power system. The system

constantly searches for potential problems that may cause malfunctions in its operation, assesses the malfunctions probability and possible consequences. After that, corrective actions are determined, their effectiveness is modeled and implemented. When the energy flows are restored, the system will operate as before. Real-time Smart Grid management requires automatic control, interaction between operators and computer systems, high data exchange speed [2].

Currently in Russia the Smart Grid concept is at the initial stage of implementation. In some regions of the Russian Federation, the Smart Grids introduction was included in the energy efficiency program. According to the Ministry of Energy of the Russian Federation, the leaders of the regional energy efficiency rating are Tatarstan, St. Petersburg, Belgorod and Murmansk regions. Consider the municipalities that are part of some of the above subjects of the Russian Federation that implement the concept of "Smart" grids.

The city of Ufa has been implementing a project for the smart power grids implementation aimed at modernizing the energy complex, namely, monitoring the electrical equipment load, monitoring emergencies and their elimination since 2013. The project implementation process began with the modernization of one microdistrict, in which the Grid Control Center was launched, which includes eight control points, as well as collecting and analyzing information from power facilities. The result of the smart grids introduction in Ufa is a reduction in the time for emergency response from 2.5 hours to 2 minutes; unauthorized connections detection; reducing the maintenance cost and equipment repair.

The Smart Grid system was introduced in the city of Belgorod: special devices were installed in a number of distribution networks that accurately determine the wire break location and allow only a small number of electricity consumers to be disconnected in this case. The complex of modern equipment and automated systems based on SAP software includes over a million units of electrical equipment. Substations equipped with a transformer monitoring and diagnostics system allow remote control and analysis of the power equipment technical condition, detecting its malfunctions at an early stage.

Belgorod is also implementing the first Russian experience in the implementation of "smart lighting", which gradually controls street lighting depending on the visibility conditions and the number of people on the street. Street networks are fully automated and remotely controlled, which allows for continuous monitoring of the state of street electrical equipment and effective metering of energy consumption [3].

In the pilot mode, the project "Smart Metering" was launched in Perm - this is an intelligent electricity metering system. About 50 thousand metering devices were installed at the pilot site, the information and computing complex of the upper level of the integrated electricity metering system was adjusted. The installation of "smart meters" provided consumers with the opportunity to take into account the real amount of energy consumed, and energy suppliers - reducing losses, eliminating cases of illegal use of electricity.

The of "smart" metering devices installation is planned to be regulated at the legislative level. So the Government of the Russian Federation has submitted to the State Duma a bill on the intelligent electricity metering systems development, which involves the introduction of "smart meters" in April 2017. In accordance with this bill, the installation of modern accounting systems will be carried out at the expense of power grid and resource supplying organizations. Certain provisions of the Smart Grid concept as opportunities for the development of the electric power industry are included in the Energy strategy of Russia until 2030.

The Smart Grid concept is being implemented at the level of local projects in Russia. The main problems that hinder the spread of technology are a significant number of consumers with different requirements for the quality of electrical energy; lack of reliable energy storage; significant financial investments in the implementation of the Smart Grid system and its subsequent maintenance; lack of standards and regulations; lack of motivation among generating companies.

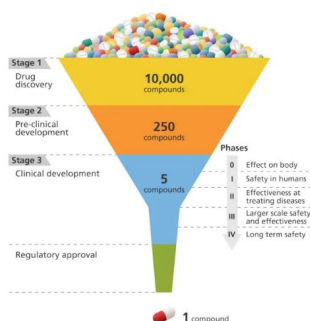
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УДК 615

AI AIDED DRUG DESIGN*Inzhievskii A.S.*

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Drug discovery is hard

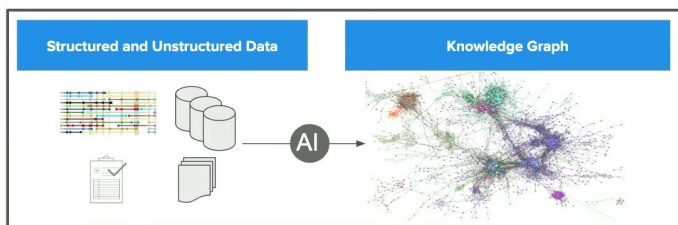
Usually to deploy one drug into the market takes around 2.6 billion dollars of investments and over 10 years devoted for initial compound selection, optimization, clinical trials and submission. The vast space of compounds that includes up to 10^{60} of possible molecules, and voluminous databases make it very challenging for scientists.

However, increasing digitization of data in the pharmaceutical sector for the last decade motivates the use of AI for organizing and applying the knowledge to solve complex clinical problems.

How AI can facilitate the process

The combination of big data and artificial intelligence can help us not only to work faster, but endow us with a greater insight into new ways to treat illnesses such as cancer and make greater medicine. Here are the main advantages of AI:

- Better work with data. Deep learning algorithms can wield data faster as well as discovering hidden correlation of symptom-disease;
- Developing new chemical compounds based on the target;
- Ability to predict features of developed compounds alleviating the necessity for redundant testing.



De novo design generative model

De novo design model is a cycle for compound development that consists of three stages that repeat themselves over time. First, experimentally and empirically obtained knowledge is used to synthesize a compound in the lab. Then goes the stage of tests to ascertain the properties of the compound (toxicity, selectivity, solubility and etc.). Finally, all the information is being added to the library and for the process to repeat itself.

Thanks to AI potential, this entire process is being emulated on hardware with the little need to engage in actual laboratory experiments that spares a great amount time.

So how does it work

Here is the visual representation of deep reinforcement learning network for de novo design generative model.

This model is divided into 2 neural networks:

- Generative model. This model is engaged in creating chemical compounds. Generated compounds this model presents as SMILES (linear representation);
- Predictive model takes output from generative model and predicts features of newly generated compounds such as selectivity, affinity, solubility and toxicity, whereby assigning numerical evaluation – reward. Then it sends feedback to generative model whose task is to maximize the reward.

Initially, both networks are trained separately with supervised learning algorithms, then during the second stage, models are trained jointly to optimize desired properties

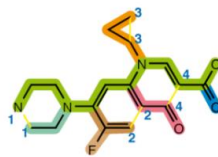
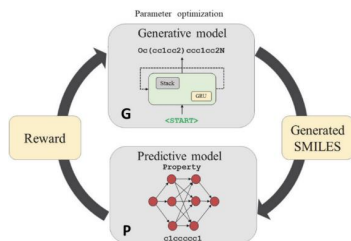
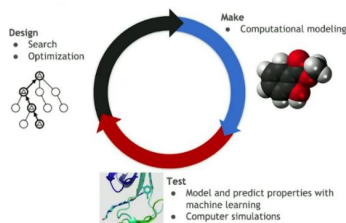
Generative model

In order to create new molecules, generative model uses text prediction machine learning akin to T9 mode in smartphone keyboards.

This model uses Long-Short-Term-Memory recurrent neural network. RNN takes an input and makes prediction of the next character. Also, RNN has memory to remember the characters it previously generated.

The model goes in three stages:

- Selection of target related compounds from public database;
- Featuring compounds with SMILES. Smiles stand for Simplified-molecular-input-line-entry-system. Basically, a text represented molecule;
- Creating embedding layer (assigning numerical descriptor) and putting trough LSTM to train it to predict characters, therefore creating new compounds.



N1CCN(CC1)C(C(F)=C2)=CC(=C2C4=O)N(C3CC3)C=C4C(=O)O



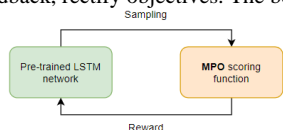
Predictive model

Predictive model uses reinforcement learning (RL). RL is a method based of rewarding desired behaviors and punish undesired ones. Thus, it can take actions and learn off its errors. This method is called Hill Climbing.

The model goes in several stages:

- Sampling compounds taken from pre-trained LSTM network;
- Score compounds According to multi-parameter objectives (MPO) or giving Reward. Reward is a numerical property assigned to a compound to estimate its worth according to necessary parameters such as selectivity, affinity, solubility and toxicity;
- Retrain and adjust LSTM network to achieve better reward.

These stages repeat themselves iteratively. Scientists usually take part in this process, give their feedback, rectify objectives. The best compounds will be used for further development.



Multi-parameter objective optimization is a concept, that implies simultaneous focus on multiple properties to find the solution satisfactory for all properties

- Affinity – binds to target well;
- Selectivity – binds only to the target;
- Toxicity – is not harmful to body. Ensues from previous two;
- Solubility – dissolves into body quick;

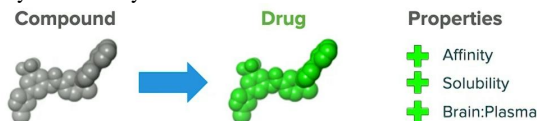
Yes, it works!

Recent use of AI in the field of ALS (Amyotrophic lateral sclerosis) helped to synthesize a more efficient compound for relatively short time (3 months to 1.5 year of market average)

Usage of AI RL helped for scientists from BERG to define important correlations between healthy cells and cancerous cells, therefore helping to produce an efficient compound to combat cancer - BPM31510.

In University of Pittsburgh, Pennsylvania, a team of scientists screened the database of more than 107 million of molecules with the help of AI and discovered an antibiotic with high antibacterial activity that can combat hitherto incurable diseases.

Overall, AI does revolutionally changes in medicine. With many opportunities of personal approach to individual patients and insights in biochemistry it gives, AI industry is growing rapidly and steadily.



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УДК 620.4

CRYOGENIC ENERGY STORAGE

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One of the most significant issues nowadays in energy industry is storing energy for further use. However, there are several perspective investigations in this direction, for instance, Cryogenic Energy Storages (CES) can be a solution to this problem.

This technology is based on the application of cryogenic liquids. During the hours when electricity is generated in excess (usually at night), it is used to cool the air from the atmosphere to a temperature at which it turns into a liquid. This liquid can be stored for a long time in vacuum containers. When there is a demand for electricity, the liquid is pumped into a heat exchanger, from where it evaporates and makes the turbine turning.

At the beginning, the air is cleaned, dehumidified and cooled to about -195 °C. Air during the transition to a liquid condition decreases in volume by about 700 times [1]. The liquefied air is stored in isolated containers at atmospheric pressure. When energy is needed, liquid air is pumped out of containers, gets heated by the temperature of the atmosphere or hot water from factories and expands, thus providing high pressure. Excess heat and cold generated by compression and expansion of air is accumulated in heat and cold storage chambers. They are used for next cycles.

This type of energy storage has a lot of advantages. Unlike many other methods of energy storage, the operation of CES stations does not depend on geographical conditions and can be built anywhere. The construction does not require expensive components and rare elements that ensures low cost, especially for long-term usage. Moreover, the storages have a long service life (about 30 years) [2]. Some storages can give out energy during 4 weeks in a row. One of the most important advantages is that this process does not produce harmful emissions.

This technology is profitable at places where electricity prices change dramatically over time. Typically, it might be used where it is difficult to vary generation in response to changing demand. Thereby it should be used in combination with the wind or sun energy stations.

CES has been successfully used in the United States and the United Kingdom. For example, Highview Power plans to build commercial stations of 50 MW / 250 MW in the north of England and 50 MW / 400 MW in Vermont in the USA [1].

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УДК 004.5

CHIPPING PEOPLE: HARM AND BENEFIT*Kuzmina L.G.*

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Introduction:

Nowadays technology is constantly developing changing human life. Over the past few years, there have been many new technological advances. For example, electronic payments, cryptocurrency, online education, and more. All this made life much easier for people. Today, almost every person has a passport, bank cards, driver's license, medical certificates and other documents. This can present some inconvenience in their storage and use. However, in the near future, each person will have the opportunity to receive a chip that will replace all documents and will also perform a wide variety of functions.

Main part:

A chip is a device implanted in a living organism that connects to the brain through neural connections. Today, two types of microchips can be used for chipping: passive and active. Active chips are equipped with a built-in battery and their own memory. This allows you to perform a wider range of functions: pay for travel, identify yourself in the system, and so on. The principle of passive chips is simpler: each chip contains a unique identifier. One chip, one function.

The development of the first chips for implantation under the human skin was carried out in the UK in 1998. This idea was invented by the British cybernetic scientist Kevin Warwick. He implanted the chip into his arm. Thanks to this, he was able to control indoor lighting, door locks and elevators. However, after nine days, the implant was removed. It is now in the Science Museum in London.

Scientists are actively working on the capabilities of the microchip. Experiments are carried out on insects, animals and even humans. The insertion procedure is considered painless since all the chips are injected. Pet owners, fearing losing their pets, implant a device with their own number. By introducing a chip into the cockroach, scientists forced it, at the behest of a computer, to accurately describe a sinusoid. Being close to the camera and people, he should have run for cover, but this did not happen. The secret of submission is that miniature stimulating electrodes were implanted into the insect's nervous system. They allowed the muscles to be manipulated from the right side of the body, forcing them to contract more or less. The commands were received by a microcircuit mounted on the back of a cockroach and equipped with a tiny battery. Today, the military uses radio-controlled beetles. Controlled beetles could carry biological or chemical weapons. In addition, there are the so-called rescue rats. They know how to find people under the rubble and transfer their location to a computer. For one of the rats, a hippocampal brain prosthesis was invented. In a rat experiment, part of the hippocampus was replaced with a prosthesis. After that, the rat continued to live as before.

There have already been attempts to introduce chips to people. Internet journalist and TV presenter Julian Assange was put under house arrest in 2010, pending trial. A microchip was sewn into the sinus of Assange's nose, with the help of which the police knew absolutely about his every step, thanks to which he did not need to come to the police and register.

In Russia, there were many people willing to voluntarily implant a variety of chips. For example, magnets in the fingers, which replace the metro pass, a car key fob that allows you to start the car without a key. For a start, scientists propose to combine all these chips into one and sew them under the skin, for example, into the palm. Such a microcontroller has a huge advantage - it is impossible to lose it, forget it at home, and most importantly, it will only be yours.

Today, microchips operate using low-frequency radio waves directed at them. Through the satellite, the chipped face can be tracked anywhere in the world. According to Dr. Karl Sanders, this

technique has already been tested during the Iraq War. Sanders invented a reconnaissance, remote operator-controlled interface biotic that was implanted in humans. As a result, supercomputers at the US National Security Agency were able to track the behavior of each soldier.

Scientists have known for a long time that every human organ works at its own frequency, and any organ can be disabled, knowing its weak point. Thus, by sending the necessary vibrations to a weak or diseased organ with the help of a chip that connects to the brain through neural connections, you can simply disable it. Considering that the world has been developing psychotropic weapons for a long time, which will be able to inspire people with different emotions and sensations, up to hallucinations; one can easily imagine what kind of weapon the personal chip will be.

One of the high-tech companies in Sweden, Epicenter, has implanted electronic chips under the skin of its employees. Tiny wireless devices are meant to replace electronic badges. People who have already acquired a radio tag say that the implantation procedure resembles a regular subcutaneous injection, and that it is done by professional tattooists.

Conclusion:

Summing up, let's highlight the positive and negative sides of chipization. Positive aspects: search and rescue of people, including missing children or children taken as hostages, etc.; helping seriously ill people through monitoring their condition using a microchip; tracking, detecting and observing people who enjoy extreme sports (hiking, skiing, climbing, diving, etc.) and who could be seriously injured in an accident.

Negative sides: violation of civil rights and freedoms; the path to total control (when both documents and money are replaced by one electronic tag, then a person is easy to control); the possibility of an increase in fraud, the creation of huge risks for every citizen; weapons of mass destruction of human consciousness.

Based on the above, we can conclude that the coming chipization is inevitable. But its influence can be different. On the one hand, this is convenience, since there will be no need to stand in queues and carry a huge amount of documents with you. Also, the chip can help people with serious illnesses in various situations. But on the other hand, the use of the chip makes it possible to control the behavior of people. And thus, humanity must selectively approach the solution of this problem.

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УДК 658.26:621.31

METHODS OF REACTIVE POWER COMPENSATION AND THEIR IMPORTANCE IN INCREASING THE EFFICIENCY OF GENERATED ENERGY

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Nowadays, we cannot imagine our lives without electricity. Most of the appliances or devices we use need, if not constant, but periodic access to electricity. Our homes and businesses are supplied with power from special electrical substations. But when power is generated, in addition to the useful power, reactive power is constantly generated, which reduces the efficiency of the generated energy.

The purpose of our study was to analyze the main ways of reactive energy compensation and identify the importance of these devices for increasing the productivity of energy production.

Reactive power is the power, which the alternating current source gives to the external circuit having reactive resistance during one quarter of the period and receives it back during the other quarter of the period. It characterizes the energy not consumed in an external circuit but oscillating between the external circuit and the source, i.e. capacitive and inductive energy stored temporarily and then given back to the source. It is expressed by the product of the voltage at the terminals of a given circuit and the reactive component of the current in that circuit. If the reactive component of the current is greater than the active component, the reactive power will be greater than the power actually consumed in the circuit.

Natural reactive power compensation does not require high material costs and should be carried out primarily at enterprises. Natural compensation includes:

- streamlining and automation of the technological process, leading to the alignment of the load schedule and improvement of the energy mode of equipment (even placement of loads by phases);
- shifting the time of lunch breaks of separate shops and sites, transfer of power-consuming large electric substations (ES) to work outside the peak hours of the power system and, on the contrary, withdrawal for repair of powerful ES during the peak hours in the power system, etc.)
- Creation of a rational scheme of power supply by reducing the number of transformation stages;
 - replacement of transformers and other electrical equipment of old designs by new ones, more perfect, with less losses for remagnetization;
 - replacement of under-utilized transformers and motors with transformers and motors of lesser capacity and their full utilization;
 - improvement of quality of electric motor repair, reduction of transient resistance of contact joints;
 - disconnection at low load (for example, at night, on weekends and holidays) of a part of power transformers.

For artificial compensation of reactive power, sometimes called "cross compensation", special compensating devices are used, which are sources of reactive energy of capacitive nature [1].

Technical means of reactive power compensation include the following types of compensating devices: capacitor banks, synchronous motors, reactive power static sources.

Centralized compensation is used at enterprises with a large number of consumers with a wide dispersion of power factor during the day, i.e. for alternating loads. In power systems of such enterprises, individual compensation is unacceptable, because, firstly, it becomes too expensive due to a large number of consumers and, secondly, the probability of overcompensation increases.

Methods and devices for compensation of reactive power in high-voltage networks are known from the state of the art, which are mainly carried out using the following means: shunt reactors; static thyristor compensators; cosine capacitors.

The technical result resulting from the implementation and use of these inventions is to increase the reliability and speed of devices for centralized compensation of reactive power, improving the quality of current in the network, as well as reducing the size and cost of the device [1].

Rational placement of compensating devices (CG) depends on the ratio of capacities of synchronous and asynchronous motors installed in 6-10 kV networks. The greatest effect is achieved when installing the CHP near the AC with the highest reactive power consumption, because it leads to the maximum reduction of power losses and electricity.

Batteries of static capacitors are most widely used as means of reactive power compensation in electrical networks with voltages up to 1 kV. Unregulated static capacitors with a capacity of at least 30 kvar are usually installed in the workshops near the power cabinets or connected to the main bus duct (group compensation). Individual compensation with the help of these devices is expedient only at large 0,4-0,69 kV power supply units with relatively low power factor and a great number of operating hours per year.

There are five main benefits to be gained from the use of power factor correction units:

- Savings in energy consumption;

The introduction of reactive power compensation units brings substantial economic benefits. The reduction of energy consumption can be up to 40-50% of the total. With such volumes, the payback period of the power compensation systems will not exceed one year.

- Increased service life of equipment;

Compensation facilities increase the service life of power transformers because their use reduces the load on the equipment. The use of compensation facilities also reduces the load on transmission lines and the heating of wires, which allows the use of conductors with a smaller cross-section.

- Cost savings for the installation of supply lines;

Installation of a reactive power compensation system during the design and construction phase of a new building can save a considerable amount of money for the installation of the power distribution network.

- Improvement of power supply quality;

The use of reactive power compensation equipment makes it possible to suppress mains disturbances, avoid deep voltage sags and minimize phase unbalance. In addition, compensation systems as part of passive filters reduce the level of higher harmonics.

- No penalty;

Reactive power compensation device allows you to avoid penalties from the electricity supplier for the deterioration of the power factor [2].

Thus, an analysis of the literature on this subject has led to the conclusion about the necessity of devices or methods that would reduce the reactive power generation, thereby increasing the productivity of energy production coming to the consumer, which will favorably affect the operation of enterprises and society as a whole.

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УДК 001.895

GRAPHEN BASED BATTERY AS AN INNOVATION IN MODERN SCIENCE

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In the modern world, we cannot imagine our life without various types of electronic gadgets. And almost all of these gadgets, due to insufficient battery capacity, discharge incredibly quickly, and can fail at any moment. If a battery with a large capacity is built into the device, the device itself will be large and heavy. Thus, there is an obvious need for energy sources that meet modern requirements.

The aim of our study is to study the possibilities of new independent energy sources based on such a material as graphene, as well as to identify their advantages over the currently available analogs from lithium. The study was carried out on the basis of an analysis of various sources available on the Internet.

Graphene is a two-dimensional allotropic modification of carbon, formed by a layer of carbon atoms one atom thick. Carbon atoms are in sp^2 -hybridization and are connected through σ - and π -

bonds in a hexagonal crystal lattice. It can be imagined as one plane of layered graphite, separated from the bulk crystal. According to estimations, graphene has high mechanical rigidity and record high thermal conductivity. The high mobility of charge carriers, which turns out to be the highest among all known materials (at the same thickness), makes it a promising material for use in a wide variety of applications.

The uniqueness of graphene is that it has the same structure as semiconductors, while it conducts electricity itself - like conductors. And it also has a high mobility of charge carriers inside the material. Therefore, graphene in photography and video technology detects signals much faster than other materials. At the same time, graphene is the most durable of the known materials: stronger than steel and diamond. The effect of graphene on the human body is not fully understood, but no one has proved the toxicity of graphene either. The only risk is that graphene is obtained by mixing carbon or graphite in water: entering the cell, its smallest particles can really kill it. However, now in bioelectronics they use a different method of obtaining graphene, which completely removes the possibility of graphene atoms to negatively affect human health [1].

The graphene battery device is a special metal-polymer case, into which two plates of dissimilar metals (copper and aluminum) are inserted with leads to provide electrical contacts - an electrolyte (liquid or solid) is placed between the electrodes. The anode contains a reducing agent, the cathode an oxidizing agent. Inside the case there is a separating plate - a separator that prevents negatively charged lithium atoms from moving freely between the electrodes.

The device of graphene batteries is similar to lithium-polymer, only in graphene batteries graphene serves as an electrolyte and a separator. The principle of operation of graphene-polymer batteries does not differ from lithium-ion batteries. The principle is the same - when charging and discharging, lithium ions constantly move between the anode and cathode through the electrolyte, while the electrons have to reach the anode or cathode through an external circuit, creating an electric current in it.

Despite the similarity in design and principle of operation, graphite batteries are superior to lithium in their characteristics - graphene accumulates charge faster due to its high electrical conductivity.

The new generation of graphene-based batteries have unique properties - the use of such energy sources will be a breakthrough in the creation of electric vehicles and the production of smartphones. Spanish developers have presented a prototype of a graphene-based battery, which has a full charge time dozens of times less than similar lithium-polymer batteries, and in fast charging mode is only five minutes.

Huawei used fast charging technology in one of its models - thanks to the graphene interspersed, 45 percent of the charge was accumulated in five minutes.

The high capacity and rate of charge / discharge of graphene batteries, as well as the low cost of their production, will be a new milestone in the production of electric vehicles.

Until now, the performance of mobile devices and phones has been significantly limited by battery life - with graphene energy sources, gadgets with incredible capabilities can be expected [2].

However, at the moment this technology has a big drawback, namely a high density, which does not allow the introduction of a graphene battery into compact devices.

Now the most promising direction in the use of this device is mechanical engineering. More and more car manufacturers are releasing their own models of electric vehicles. Using graphene-based batteries instead of lithium batteries can increase the range of cars by 3-4 times.

For example, Graphenano has developed the Grabat battery, which can provide an electric vehicle's range of up to 800 km. Capacitance 2.3 volt Grabat enormous: about $1000 \text{ W} \cdot \text{h} / \text{kg}$. For comparison, the best examples of lithium-ion batteries have a level of $180 \text{ W} \cdot \text{h} / \text{kg}$. The developers claim that the battery can be charged in just a few minutes - the charge / discharge rate is 33 times faster than that of lithium-ion batteries. Discharging quickly is especially important to ensure high acceleration dynamics for electric vehicles. Graphene batteries are less bulky than their

lithium-ion counterparts: the mass of a graphene battery is half that of a lithium-ion battery. And last but not least, these batteries cannot explode [3].

Thus, graphene-based storage batteries, which have very significant advantages over lithium counterparts, will occupy the mass market in the near future and will push the development of technology to a new level.

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УДК 620.92

GEOHERMAL RESOURCES AS ONE OF THE PROSPECTIVE ENERGY SOURCES

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At the moment, the most popular power plants using the planet's renewable resources are wind and hydroelectric power plants. But there is also a less common way of producing energy, based on the high temperature of the Earth's core.

The purpose of our work is to determine the main advantages and disadvantages of geothermal power plants, as well as analyze their characteristics in comparison with other power plants. The research was carried out on the basis of the analysis of available electronic sources of information.

The transformation of heat from the bowels of the earth into the energy required by the consumer occurs at the expense of geothermal power plants, shortly GeoPP. There are three main types of geothermal power plants, which differ from each other by the method of operation:

1. Hydrothermal plant. In this type of plant, steam coming from underground works in direct contact with steam turbine. The steam is supplied to the turbine blades, the rotation movement of which is imparted to a generator that produces electric current [1].

2. Petrothermal station. The petrothermal principle involves the injection of water into a deep well with heated rock, where the liquid turns into steam and returns back to the turbine of the power plant. It is necessary to drill at least two wells: water will be supplied to one from the surface in order to turn into steam from the heat of the rocks and exit through another well. Then the process of generating electricity will be completely similar to the hydrothermal station [2].

3. Binary geothermal station. If you have a well with steam-water mixtures with a temperature above 150 ° C but not steam, then you will need a combined cycle plant. Before the turbine, the separator will separate steam from water - steam will go to the turbine, and hot water will either be discharged into the well or sent to the expansion tank, where it will give additional steam for the turbine.

The main advantage of geothermal energy is its inexhaustibility, which is the reason why it is considered a renewable energy source. Wells drilling, geothermal power plants construction and pumping water or using water / steam from geothermal sources is physically incapable of causing decrease of the Earth's core temperature or somehow exhaust this resource.

Geothermal energy is more stable than other forms of energy. It does not depend on weather conditions or time of day, unlike solar and wind power, or on the supply of fuel to run thermal power plants and nuclear power plants. It also makes it possible to build power plants even in hard-to-reach areas and remote regions with poor transport infrastructure. Geothermal energy, unlike solar or wind energy, does not require a large area to locate facilities. For instance, to generate 1 GWh/year a geothermal power plant would require as little as 400 m² while a similar solar plant would require over 3 km² of floor space.

If all safety conditions are met, geothermal power plants are almost environmentally friendly and produce very little carbon dioxide, and together with electricity they can be used to extract minerals, such as metals and gases dissolved in the steam-water mixture.

With all its advantages, GeoPPs have disadvantages. As mentioned above, subject to safety conditions, these stations do not harm the ecosphere, but this does not negate the fact that the working fluid at the GeoPP is dangerous and contains heavy metals, for example, lead, arsenic or ammonia, which can cause a local disaster in the event of an accident. Additionally, GeoPPs are less powerful than hydroelectric power plants, thermal power plants and, moreover, nuclear power plants, and the cost of a kilowatt in them is higher. This is due to the fact that, with all the simplicity of the design of the power plants themselves, huge investments are needed for high-quality geological exploration and soil analysis. The approximate level of capital expenditures in this segment is at the level of \$ 2800 / kW of installed capacity, which is significantly higher than that of gas-fired thermal power plants, wind and solar power plants [3].

Let's compare the Mutnovskaya GeoPP with the Yumaguzinskaya Hydroelectric Power Station, the Ulyanovskaya WPP-2 and the Novosergievskaya SPP (SPP Neptune). Their characteristics will be shown in Table 1.

Table 1. Characteristics of different types of power plants

Name	Capacity, MW	Cost kWh, rub / kWh	Occupied area, km ²
Mutnovskaya GeoPP	50	4-7	0.11
Yumaguzinskaya Hydroelectric Power Station	45	0,5-2	150
Ulyanovskaya WPP-2	50	10-12	0.008
Novosergievskaya SPP	45	17-20	0.92

Having almost the same capacity, GeoPP is ahead of power plants by cost of kWh of energy, giving way only to HPPs, and also occupies the smallest area, losing only to WPPs [4].

Thus, we can conclude that the use of geothermal resources in some regions is a promising option for generating electricity, next-best in efficiency to more popular solutions that also use renewable energy sources.

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УДК 621.318

DYNAMIC WIRELESS CHARGING FOR ELECTRIC CARS***Labutkin Rodion A.***

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The global electric vehicle market, even during the pandemic in 2020, showed an increase of 5% compared to an 18% drop in vehicle sales [1]. Three of the ten largest car manufacturers produce only electric cars. Every week car companies announce the launch of new electric vehicles and the abandonment of ones with the internal combustion engine. The process resembles a "wave" that has been gaining strength for over 10 years, and now it embraces the whole world and gradually penetrates Russian market.

According to RBC, in 2026, electric vehicles will account for half of all transport sales. And 45% of Russians would like to switch to electric cars, as they consider them to be more environmentally friendly and safer [2]. One of the obstacles to mass production and spread of electric vehicles is the lack of charging infrastructure around the world. Many regions still lack the infrastructure necessary to ensure that electric vehicle owners can drive comfortably without constantly searching for the nearest charging station. If the number of electric cars increases significantly, then there will be a problem with their recharging. It takes 2-3 minutes to refuel a car with an internal combustion engine and it takes at least 30 minutes to recharge an electric car. In today's world, few people want to spend so much time refueling a vehicle. In addition, the travelling range is small, only 300-400 kilometers.

In this paper I will try to give an example how to solve this problem. Namely, the development of charging carriageway for electric vehicles will be considered. This technology will allow to power electric cars without using a wired connection. According to the project, the car be powered while it is parked or it is moving. Since the charging infrastructure will essentially be built into the roads themselves, the system will also significantly reduce the need for charging stations and large batteries. In theory, it could also allow autonomous vehicles to drive without stopping to charge.

Highways for charging electric vehicles operate through a system of copper coils embedded in the road. Instead of being an DC current, the current fluctuates, which means it changes direction very quickly. This creates a small, localized magnetic field that continually reverses polarity. Stronger current and faster oscillation produce stronger magnetic field. The energy from these coils is transferred to the vehicle batteries via magnetic induction. The charging system requires the control unit to be located on the side of the road and the receiver to be installed in the chassis of each vehicle.

There is also a wired charging option used on trolleybuses. An electrical line can be constructed over the motorway and a bow can be installed on the roof of the electric vehicle, which is used to transmit energy. The following advantages of wireless technology can be distinguished.

1) Durability of wireless charging. Energy is transmitted without physical contact, so there is no friction.

2) No network of wires over the road. For installation of only one cable for one lane, you will need not only the cable itself, but also catenaries and poles holding the structure together. Moreover, if you need 2-3 stripes, then it becomes 2-3 times heavier.

3) No risk of short-circuit of wired charging. A failure in the wire will cause problems in using the road. A breakdown in the wireless charging there are no such problems since the charging equipment is installed underground (the earthing is already built in).

4) For wireless infrastructure it makes no difference if a car passes once every 5 seconds or once every 5 minutes. The vibration of the wires from a single trolleybus travelling at 40-50 km per hour is already considerable. A huge amount of fixing material is needed to withhold that vibration. On the other hand, light vehicles are much faster and a lot of them are already available.

However, there is one disadvantage. The power of wired charging reaches 170 kW, whereas the power of wireless charging reaches only 70 kW depending on the number of modules [3].

Some wireless charging equipment has already been tested. In January 2021, a 1.65 km long dynamic wireless charging system was completed on a public road in Gotland, Sweden. The electric 40-ton truck, equipped with five 20 kW wireless modules, was charged from the road while driving at the speed up to 60 km / h on a 200-meter section of a 70 kW electric road [3]. The system has achieved stable performance with consistent results, and tests have confirmed that ice and snow do not affect wireless charging capabilities.

In Italy, a 1,050 meter wireless charging lane will be built on the ring road from the Chiari Ovest exit of the A35 motorway, about 50 kilometers from Milan. Copper coils and a roadside control unit will be installed under the road. Previous tests of this system have shown that batteries are charged approximately to 70 kW during one hour of charging [4].

To sum up, it should be noted that wireless charging will make it easier to operate electric vehicles as consumers will be no longer need to spend time recharging, and travelling range will also be increased, which allows longer trips using the electric vehicle. Vehicle electrification is only a matter of time, and you can start taking care of your future today.

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SUPERCONDENSERS AS A SOURCE OF ENERGY FOR URBAN ELECTRIC TRANSPORT

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The main type of storage device for electrical energy now are chemical sources - batteries. However, there is at least another interesting type of device, the supercapacitor or ultracondenser. Unlike batteries, which receive and produce electricity through chemical reactions between electrodes, they do not produce anything, but store and give up the charge in a ready-to-use form.

The target of our work is to determine the main advantages and disadvantages of supercapacitors, and to analyze their characteristics in comparison with lithium-ion batteries. The research was based on analyzing of available electronic sources of information.

A typical capacitor consists of two plates of conductor separated by a thin layer of dielectric. A capacitor is designed to store charge, i.e. electrical energy. The main characteristic of a capacitor is its capacity. It is directly proportional to the area of the plates and inversely proportional to the distance between the plates. The unit of capacity of a capacitor is 1 Farad. Supercapacitors have porous plates rather than conventional plates which have a larger area. And the areas of these

irregular plates are brought together using an electrolyte. So that no current flows through the electrolyte, the plates must have different conductivity: ionic and electronic. Now, graphene is used to cover the plates.

The advantages of supercapacitors over lithium-ion batteries are as follows:

1. Principle of energy storage. In rechargeable batteries, energy is stored chemically, so it has a limited number of cycles. In supercapacitors, energy is stored electrically. The number of charge/discharge cycles is huge (over 500,000).

2. If you choose an electrolyte of high density, the operating temperature can be from -40 to +65 °C [1].

3. Charging speed is minimal. The charging time for the large-capacity supercapacitor battery is extremely short, less than five minutes [1].

4. A supercapacitor can give off a lot of energy in a short time. Even a bulk truck can quickly make a move on it [1].

5. A supercapacitor without loss of properties can be in a completely discharged state (sleep) for a very long time [1].

In addition to the positive properties of supercapacitors, there are also negative ones that prevent it from being used anywhere, primarily:

- low specific capacity (approximately 10 times less than batteries);
- linear characteristic of the voltage on the capacitor during discharge (at the beginning of the discharge about 3 Volts, in the middle 1.5 Volts, and for normal power supply it is necessary to have 3 Volts) [1];
- large self-discharge (a supercapacitor can be discharged by half within a week);
- high cost of a supercapacitor;
- low operating voltage (2.7 Volts) [1].

Let's compare supercapacitors with lithium-ion batteries in several key parameters. For clarity, we will use Table 1 [3].

Table 1. Characteristics of the supercapacitor and lithium-ion battery

Specifications	Supercapacitor	Standard lithium-ion battery
Charging time	1-10 seconds	10-60 minutes
The number of cycles	1 million or 30 thousand hours	500 and above
Cell voltage	2.3 to 2.75 V	3.6V nominal
Storage density (W * h / kg)	5 (standard)	120-240
Specific power (W / kg)	Up to 10 thousand	1000-3000
Cost per kilogram of watt	\$ 10000 (standard)	\$ 250-1000 (large systems)
Lifetime	10-15 years old	from 5 to 10 years
Allowable charging temperature range	from -40 °C to 65 °C	from 0 °C to 45 °C
Allowable discharge temperature range	from -40 °C to 65 °C	from -20 °C to 60 °C

A supercapacitor can be charged and discharged almost unlimited number of times. Unlike an electrochemical battery, which has a life cycle of a certain size, a supercapacitor is practically insensitive to the effects of cyclic operation. Age-related changes associated with materials degradation also have a weaker effect. Under normal conditions, the capacity of a supercapacitor after 10 years of operation remains at 80% of the nominal. However, working with high voltages

can reduce its lifetime. It is also worth noting the advantage of the supercapacitor in terms of temperature indicators - the weak point of all electrochemical power sources.

The useful properties of a supercapacitor are used by specialists in various fields, including car manufacturers. Supercapacitor have already found their application in public transport. In 2017, the Belarusian "Belkommunmash" presented AKSM-E433 Vitovt electric bus equipped with ionistors. It can travel 12 km on a single charge, and it takes 7 minutes till supercapacitor is fully charged[4]. Considering that the city bus stops every few hundred meters, and its route rarely exceeds a couple of tens of kilometers, it can be charged at the end stops.

In this regard, we can make a conclusion that use of supercapacitor in public transport in Russia is quite promising due to fast charging, durability, and a wide range of operating temperatures.

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УДК 8.80

METAPHORICAL USE OF MILITARY VOCABULARY IN ENGLISH LANGUAGE

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Military metaphors have been part of our language for hundreds of years. This is normal, as people often use their experience in one area for another. Military vocabulary is very productive in the development of figurative meanings and its metaphorical use extends to many areas of life. Literally hundreds of military metaphors are used in everyday speech and writing.

This article is devoted to the study of the functioning of military metaphors in the English language. The authors consider texts on various topics, such as politics, sports, health care, culture, and highlight the most typical types of metaphors for a particular area. To analyze the representative material we have used the following research methods: generalization, analysis and the method of description.

Today you can ask someone to "to spearhead the discussion" or "to get off your high horse; from drill passed the phrases "get off on the wrong foot" or "mark time"; from the strategy - "close ranks", "beat a hasty retreat"; from weapon terminology - "cross swords", "look daggers"; from the military hierarchy - "the top brass", "rank and file".

People often think of "love as war": "She fought for him, but his mistress won out", "He won her hand in marriage", "She is besieged by suitors", "She has to fend them off", "He made an ally out of her mother", "He is known for his many conquests". Such connected groups are viewed as structural metaphors, and these metaphors can become part of our unexpressed belief system [1].

Research shows that military vocabulary is also used in the fields of politics, economics, environment and health. Here is one example from one of the election campaigns: "Charest made a blistering attack on the Liberal record", "He's not targeting the Bloc", "He has a shot at becoming prime minister", "Federalist forces could easily rally against separatists", "He has been an underdog,

fighting to keep the politicians in Ottawa honest", "He devoted his entire speech to attacking the Liberals".

In their book *Language and the World*, Schaffner and Wenden argue that such structural metaphors do not exist in our representational system as separate ideas, but are linked together and organized into metaphors at a higher ideological level. The authors conclude that the language of journalists and diplomats often represents an ideological bias that accepts and supports war as a legitimate way to resolve international relations and intergroup conflicts; language undeniably develops values, maintains certain relationships and inspires actions that create conditions leading to war; and that language itself creates the image of the enemy necessary to provoke and sustain hostility that can help justify war [2].

Recognizing the metaphors that are contained in the language we use should be part of every person's education. Schaffner and Wenden write about the necessity of teaching critical language in the book *"Language and World"* [2]. Elements of such an education may include the following:

- Develop an awareness of metaphorical language. The study of metaphors can be introduced at an elementary level, starting with simple examples and moving on to more complex ones. Studying the use of metaphors in political and other speech would provide insight into how language reflects ideology and can influence the exercise of power.

- Develop metaphorical language decoding skills. One model for formal analysis is to identify conceptual and structural metaphors and to "map" the latter, drawing intentional parallels between the structural metaphors and the topics discussed. This can then provide a basis for a critical generalization of the way of metaphorical reasoning.

- Recognize the limitations of metaphors. Of course, metaphors help expand our understanding of what we are already familiar with, however, a system that allows us to understand one aspect of a concept through another (for example, a dispute in terms of war) necessarily obscures some aspects of the concept. There are aspects of the dispute that are incompatible with war. We may lose opportunities to cooperate in an argument, exchange views that differ from our position, or learn from another person's arguments.

So, all this shows the need to study metaphors, their use in speech, since the language we use affects behavior in a significant way. Our conceptual thinking is formed in an unconscious way and therefore it is necessary to make sure that the language we use allows us to achieve our communicative goals.

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УДК 621.317+611.127

THE INFLUENCE OF POWERLINE INTERFERENCE FILTERING ON SIGNAL-AVERAGED ELECTROCARDIOGRAPHY PARAMETERS FOR TELEMEDICINE APPLICATION

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Late ventricular potentials (LVP) are high-frequency low-amplitude oscillations located at the end of the QRS complex in electrocardiosignals (ECS). LVP registration is an important task for telemedicine because the presence of LVP with a high probability indicates the development of cardiovascular diseases [1].

The problem of LVP registration is that they are difficult to detect at standard electrocardiograms. Various kinds of interference can significantly affect the electrocardiosignals, therefore, filtering of interferences is an important in LVP registration problem solution.

The main method for LVP registration is signal-averaged electrocardiography (SAECG). That approach is based on averaging of many cardiocycles, which allows to increase the signal-to-noise ratio. However, before the SAECG, it is necessary to perform preliminary signal processing. At this stage powerline interference at 50 Hz frequency can influence on ECS. Guaragnella C., Rizzi M., Giorgio A. in [2] analyzed ECS from the PTB Diagnostic ECG Database [3] and filtered not only interference at 50 Hz, but also its harmonics (frequencies that are multiples of 50 Hz), which led to successful LVP registration in more than 90% of cases. However, there are no works that would demonstrate how exactly it is necessary to filter powerline interference: is 50 Hz filtering enough or additional harmonics filtering is required.

Based on this, a hypothesis is formed: additional powerline interference harmonics filtering impacts on SAECG parameters.

To test this hypothesis, we used the Matlab program complex with the Signal Analyzer utility in DSP system toolbox packet for filtering of ECS from the PTB Diagnostic ECG Database.

For this study 6 ECS records of patients with myocardial infarction were analyzed. In every signal QRS complex was prolonged, which may be a potential feature of LVP. The ECS analysis for LV presence or absence is performed in according to Simson method [4] for three Frank leads: orthogonal leads X, Y, Z. An example of analyzed ECS is presented at Fig. 1.

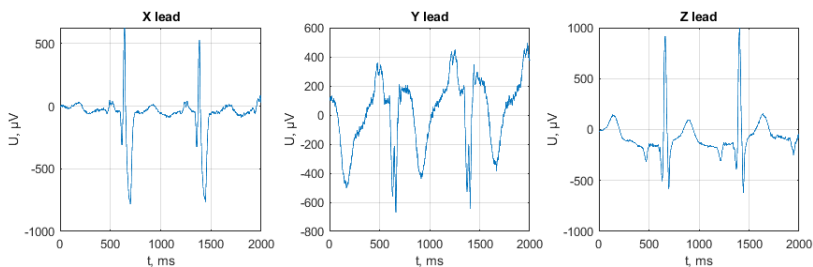


Fig. 1. ECS from X, Y, Z leads.

The first step was to filter signals using bandpass filter in 2÷400 Hz frequency range to reduce baseline noise and high-frequency noise. Further the signals from three leads were filtered using notch filter at 49÷51 Hz frequency range to reduce 50 Hz powerline interference without additional harmonics filtering. After that cardiocycles were extracted, accumulated and averaged to increase signal-to-noise ratio. R-peaks were chosen as synchronization points. Duration of the analyzed sections was 512 ms. Set of extracted cardiocycles in analyzed ECS is presented at Fig. 2.

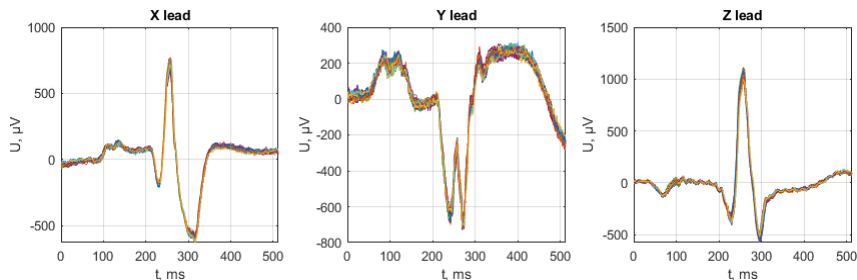


Fig. 2. Extracted cardiocycles before averaging.

Then bidirectional filtering of the averaged cardiocycles was performed in the 40÷250 Hz range. Finally, the values of vector magnitude were calculated in according to equation (1):

$$\rho = \sqrt{x^2 + y^2 + z^2}, \quad (1)$$

where x, y, z - filtered averaged cardiocycles voltage values from X, Y, Z leads.

And last step was an analysis of three detection criteria. The detection criteria were:

- duration of the filtered QRS complex: fQRS \geq 114 ms;
- duration of signals less than 40 μ V in terminal part of fQRS: LAS40 > 39 ms;
- root mean square voltage in the last 40 ms of fQRS: RMS40 < 25 μ V.

Fulfillment of at least two of these conditions results to LVP presence in ECS.

After evaluating these parameters for every ECS, all mentioned steps were repeated again but at the stage of preliminary processing signals were filtrated at 49÷51 Hz, 99÷101 Hz, ..., 399÷401 Hz frequency ranges to reduce powerline interference harmonics impact.

As a result, obtained parameters are compared for the first and second cases, and conclusion about additional powerline interference harmonics filtering influence on SAECEG parameters and its result is made.

Table 1 shows the results of analyzed signals using Matlab.

Table 1. Changes of SAECEG parameters and its results.

Signal	Detection criteria			L VP
	fQRS, ms	LAS40, ms	RMS40, μ V	
First signal (50 Hz filtering)	133(+)	40(+)	38,4(-)	+
First signal (harmonics filtering)	126(+)	37(-)	42,6(-)	-
Second signal (50 Hz filtering)	141(+)	41(+)	29,3(-)	+
Second signal (harmonics filtering)	140(+)	40(+)	32,7(-)	+
Third signal (50 Hz filtering)	148(+)	58(+)	18,8(+)	+
Third signal (harmonics filtering)	150(+)	50(+)	18,5(+)	+
Fourth signal (50 Hz filtering)	118(+)	33(-)	43,7(-)	-
Fourth signal (harmonics filtering)	118(+)	33(-)	43(-)	-
Fifth signal (50 Hz filtering)	130(+)	38(-)	40,7(-)	-
Fifth signal (harmonics filtering)	130(+)	39(-)	40,6(-)	-
Sixth signal (50 Hz filtering)	154(+)	40(+)	35,7(-)	+
Sixth signal (harmonics filtering)	153(+)	40(+)	36,1(-)	+

All cases have at least one changed SAECEG parameter: fQRS was changed in 4 cases (66%), LAS40 was also changed in 4 cases (66%) and RMS40 was changed in 6 cases (100%).

In 3 cases (50%) all SAECEG parameters were changed. Two of three SAECEG parameters were changed in 2 cases (33,3%), one SAECEG parameter was changed in 1 case (16,7%).

In 1 case (16,7%) significant changes of SAECEG parameters were observed: fQRS was decreased by 6 ms, LAS40 was decreased by 3 ms, and RMS40 was increased by 4,2 μ V. As a result of these changes, the decision about LVP presence/absence in ECS was also changed. Graphic interpretation of this case is presented at Fig. 3.

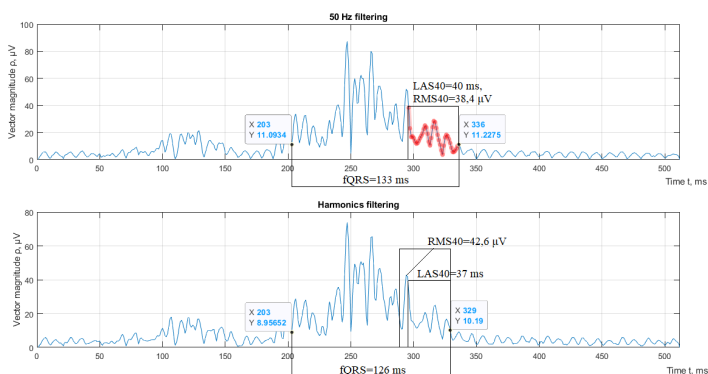


Fig. 3. Powerline interference harmonics filtering impact.

In other 5 cases (83,6%) the decision about LVP presence/absence in ECS was the same.

Thus, we can form the conclusion that additional powerline interference harmonics filtering influences on SAECG parameters and, as a consequence, can affect on decision about LVP presence/absence in ECS. In future studies we will increase the sample of ECS with the purpose to make more detailed analysis of SAECG parameters changes.

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УДК 620.22

THE USE OF VITRIMERS IN COMPOSITE MATERIALS

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This paper analyzes vitrimers and their difference from the main classes of plastics used in aircraft construction, and discusses the prospects for using vitrimers in composite materials, and provides examples of spheres in which vitrimers can be used.

In modern aircraft industry, the use of composite materials is steadily growing every year. In this regard, the technology of manufacturing parts from composites is being improved, as well as methods of their control and repairs. In any material, microcracks and other defects appear over time, which can lead to a loss of strength of the part with the possibility of subsequent destruction, and composites are no exception. In this regard, materials capable of self-healing become highly relevant.

There are two main classes of plastics used in the aviation industry: thermoplastics and reactoplastics. Each of them has its advantages and drawbacks. Thermoplastics are high-tech, they

can be melted and processed, but their mechanical properties leave much to be desired; products made of them are subject to deformation. Reactoplasts have good mechanical and thermal properties, but because of their structure they cannot be recycled and reused.

Scientists have developed a vitreous material which combines the advantages of both thermoplastics and reactoplastics. Strong and durable, like thermosetting plastics, but at the same time suitable for molding and processing, like thermoplastics, vitrimers are permanent networks of polymer chains connected by dynamic covalent bonds that allow the network to change its topology, while maintaining a constant number of chemical bonds at any temperature [1].

Vitrimers are covalently bonded crosslinked mesh polymers, such as thermosetting polymers, but with one distinctive feature – the chemical bonds in the mesh are interchangeable. Usually, the resin contains a catalyst that allows for bond exchange reactions when the material is heated above the transition temperature to the vitreous body. When vitrimers are heated to a plastic state, their total crosslinking density remains constant, but the rate of bond exchange increases with temperature rise, since all chemical reactions proceed faster at higher temperatures. This leads to a gradual decrease in viscosity with temperature rise, which differs from the relatively sharp drop in viscosity during melting of thermoplastic materials.

The ability to flow allows vitrimers to be reprocessed and recycled. The selective cleavage of the dynamic links in vitrimers allows differentiating dynamic crosslinks from the static ones. The selective cleavage of the dynamic links can also be a practical route to the closed-loop recycling of vitrimer composites. This approach was successfully used to quantitatively recover and separate the carbonfibers and the polymer matrix in polyimine and polyester vitrimer composites. The reclaimed fiber and resin could be reused to produce new composites possessing the same mechanical properties as the original material [2].

The reversible nature of vitrimers allows welding, molding, reshaping and processing fully cured materials, while they do not lose their original strength.

These properties of fiberglass make its use in composite materials promising. Composite products are often used in extreme conditions and are subjected to high loads. Thanks to the usage of vitrimers, the repairs of such products can be carried out by the local heating method, which will simplify and speed up this process several times. Due to the possibility of recycling, the use of vitrimers will also have a positive impact on the environment.

Besides this, using vitrimers will make it possible to increase the shelf life of semi-finished prepregs for the manufacture of composite parts, since prepregs impregnated with vitrimer do not need to be stored at a certain temperature, they can be stored initially in a cured state and, if necessary, heated, giving them the necessary plasticity.

Thus, due to the unique properties of vitrimers, it is possible to improve the maintainability of composite materials based on them, their manufacturability and environmental friendliness.

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APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN THE LAW FIELD*Pyrnova O. A.*

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In our modern, rapidly developing world, artificial intelligence is becoming an integral part of it. AI penetrates into various aspects of society and has practically touched every niche. The law could not be ignored either. Artificial intelligence solves many of the problems associated with the automation of tasks that usually require "human intelligence". For example, it is used for playing chess, translating languages and driving vehicles. However, modern artificial intelligence systems are not, in a sense, intelligently thinking machines.

One of the important branches of artificial intelligence is that aspects such as logical rules and knowledge representation are possible. The goal of this area of artificial intelligence is to model real-world phenomena or processes in a form that computers can use, typically for automation purposes. This often involves programmers providing the computer with a set of rules that represent the underlying logic and knowledge [1]. Knowledge representation has a long and distinguished history in the field of AI research and has contributed to many so-called expert systems. In an expert system, programmers, together with specialists in certain areas, such as medicine, seek to model this area of knowledge in a computer-understandable form. Typically, system designers try to translate expert knowledge into a set of formal rules and structures that a computer can process. Once created, such a medical expert system could allow downstream users to make automatic expert-level diagnoses using encoded knowledge (for example, if a patient has symptoms X and Y, the expert system uses its rules to determine that it is probable disease Z). A good example of a legal expert system is tax preparation software such as TurboTax. To create such a system, software developers, in consultation with tax attorneys and other experts on personal income tax laws, translate the meaning and logic of tax regulations into a set of comparable formal rules that a computer can process.

Imagine there is a tax law that says that for every dollar of income in excess of \$ 91,000, it will be taxed at a marginal tax rate of 28%. A programmer can take the logic of this legal provision and translate it into a computer "if-then" rule that accurately reflects the meaning of the law (for example, if income > 91,000, then the tax rate = 28%). Once this rule is formally introduced, the software can use it to analyze the revenue reported by the registrar and automatically apply the appropriate tax rate to it. The same can happen with many other translated tax provisions. This example illustrates the basic logic behind the process of transforming a law into a computer. More broadly, these methods, based on the knowledge, logic and rules of AI, involve a top-down approach to computing. This means that programmers must provide the computer with all its rules of operation and decision-making in advance. However, this is at odds with the machine learning approach, in which a computer algorithm defines its own rules of operation.

Although rule-based representation systems have not had the impact that machine learning systems have, they can combine facts about the world using logical rules to alert users to things that people might be too difficult for to figure out on their own. In addition, knowledge-based artificial intelligence systems can use computing power to uncover hard-to-find details, such as inconsistencies embedded in systems that humans cannot recognize [2]. They can also engage in complex chains of computer reasoning that would be too difficult for a human to do. For example, not every person will be able to understand in detail any point related to tax payments.

Undoubtedly, it should be noted that many modern artificial intelligence systems are not completely machine or knowledge-based systems, but are hybrids of these two approaches. For example, self-driving cars are equipped with trained machine learning systems to help them drive. The system learns to drive itself through a repetitive learning process through which it

automatically determines the appropriate driving behavior. However, much of self-driving car behavior also involves clear rules and representations of knowledge. Thus, for an artificial intelligence system as complex as a self-driving vehicle, it must rely on a combination of artificial intelligence technologies, including machine learning models, as well as hand-written rules for representing knowledge of the world.

We must not forget that artificial intelligence gradually penetrates into all spheres of human life, and this applies to legal activities. In essence, "AI and Law" involves the use of computer and mathematical methods to make the law more understandable, manageable, useful, accessible, or predictable. More recently, since the mid-twentieth century, several researchers have actively taken ideas from computer science and artificial intelligence and applied them to the laws of their countries. Since at least 1987, the International Conference on Artificial Intelligence and Law (ICAIL) has regularly held conferences demonstrating the application of these artificial intelligence techniques to legislation. Also, since about 2000, AI and jurisprudence have moved from methods of knowledge representation to approaches based on machine learning. Many of the latest AI and legal applications are created by legal technology startups that use machine learning to make law more effective or efficient. Other more advanced breakthroughs in artificial intelligence and law have occurred in interdisciplinary university legal research centers such as Stanford University's CodeX Center for Legal Informatics. One useful way to think about using AI within the law today is to conceptually divide it into three categories of AI users:

- Administrators of the law (that is, those who create and enforce the law, including government officials such as judges, legislators, administrative bodies). officials and police);
- Practicing lawyers (that is, those who use AI in legal practice, primarily lawyers). For example, document checking has traditionally been a task performed by lawyers who quickly read each document and indicated, often manually, whether the document was legal or not. In the mid-2000s, with the advent of electronic discovery, so-called smart coding and technology-assisted viewing became possible;
- Guided by the law (that is, people, businesses and organizations whose activities are regulated by law and the use of the law to achieve their goals).

In addition, for each of the categories, it was necessary to provide for a massive contract review, which helps to automatically combine contracts and other legal documents. Also, do not forget about such an ability of artificial intelligence as predicting legal results. One of the functions that attorneys have traditionally performed for clients is assessing the strength of the client's arguments and his legal position in a hypothetical or actual litigation. Lawyers and others interested in the outcome of court cases are increasingly using machine learning systems to make predictions about the outcome of cases and rely on data rather than instinct.

It is important to emphasize that these artificial intelligence systems can quickly reach their limits. These technologies often simply provide a rough first pass through many of the lawyer's tasks, such as providing a document template for a lawyer. In other cases, the program may simply highlight legal issues that a lawyer should be aware of. In contrast, in more complex situations, the end result is that the AI software does not usually produce a final work product, such as a complete written merger agreement.

Finally, there are several important current AI issues and legal issues to look out for. While a fuller discussion is beyond the scope of this article, it is important to bring them to the attention of the reader. One of the most important contemporary problems is associated with the possibility of bias in algorithmic decision making. If government officials use machine learning or other models of artificial intelligence to make important decisions that affect people's lives or freedoms (for example, criminal penalties), it is important to determine whether the underlying computer models treat people fairly and equally [3].

Thus, this article shows that modern artificial intelligence technology has its limitations. Knowing the strengths and weaknesses of modern AI technology is critical to understanding AI within the law. This helps to have a real understanding of where AI can influence the practice and application of the law, and just as importantly, where it is not [3].

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УДК 519.68

CREATE THE CONTROL PROGRAM FOR A CNC MACHINE**Rossomakhin A.A.**

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Abstract

This thesis examines the stages of preparing a control program for a CNC machine. A method for preparing a control program for a CNC machine tool using CopperCam programs is proposed.

Stages of preparing the control program

In our case, the CopperCam program, created specifically for milling printed circuit boards, will act as a postprocessor. To begin with, we design the board in the Sprint-Layout CAD system. On this board there is a place for conductors and contacts, and 3 holes.

Next, you need to export the Gerber file of the board and the hole drilling file. There is one nuance when exporting. In everyday life, we use millimeters to work in the program, i.e., all dimensions, grid, etc. are measured in mm. The CopperCam program does not recognize these units of measurement, and for the exported Gerber file and the drill file to be read and all sizes to match, it is necessary to switch the units of measurement to mil in it before exporting the necessary files from Sprint-Layout.

Next, we export the board and the holes on it. Select the File item, select the "Export" item in the list that opens and select "Gerber Format".

Next, the export settings will open. Check the box next to the exported layer. In our case, "F1-foil at the top", if you are spreading the board on the "F2-foil at the bottom" layer, put a check mark on "Mirror display". otherwise, we will first get an incorrect image of the board. Then put a check mark next to "Board size frame". Select the "Create Gerber file" section and after a while a message will appear indicating the path of our file and its name. Close the Gerber file export dialog box, click the "File" button, then "Export" and select the "Excellon Format" item. The "Save As" window will appear, click on it and save it to where the Gerber file is. Open the CopperCam program.

We upload previously created Gerber files and drilling into this program. To do this, in the upper menu bar of the program, click on the "File" tab, the "Open" item, select the "Additional layer" item from the drop-down menu. A dialog box opens in which you need to show the location of the previously created Gerber file, select it and click the "Open" button. CopperCam automatically detects the outline of the board and asks about the correctness of the boundaries in the window that appears. The borders are set correctly, therefore we press the "Yes" button. We have uploaded the Gerber file. Next, you need to download the drilling file, for this we also go to the previously known path "File", the "Open" item, and select the "Drills" item from the drop-down menu.

In the window that opens, we also specify the path to the drill file and click the "Open" button. It is necessary to enter data into the program about the tool. To do this, open the menu "Parameters" - > "Tool library..." in the top line of the program.

In the window that opens, select the tool data. It is necessary to configure the board processing operations themselves. To do this, go to the menu "Parameters" -> "Selected tools..." "CUTTING TOOL - cutting tool.

We set Cutting depth - the cutting depth = 1.6 mm, and Cutting speed - the feed speed of the cutter = 1 mm. DRILLING TOOLS - a tool for drilling.

If all the holes on the board are smaller in diameter or equal to the diameter of the cutter used, then the speed can be raised to 4 mm/s. In the case when the holes for bolts and other elements, then do not put this speed more than 1-2 mm / s, because if the speed is high, you can break the cutter, or because the cutter will not have time to process the surface, the holes will not be completely round.

Click on the Calculate controls icon. Click "OK", after some time the program will give the result. If the ready-made version is suitable, you need to upload the files with the G-code. You need to find and click on the Mill button, and a panel will open to create a file with the UP or G-code for the machine. Click on it and see the panel for creating files with the control program, aka the G-code for the machine. Select the first operation - Drilling (single tool) and click OK. After that, the program will open a notepad in which it will save the G-code. We save the notebook where it is convenient. Then they closed the notebook and selected the "Engraving layer 1" operation and performed the same actions with Drilling (single tool). As a result, we got 2 files with a G-code.

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УДК 621.317 + 611.127

REVIEW OF VENTRICULAR LATE POTENTIALS DETECTION PROBLEM IN RUSSIAN FEDERATION TELEMEDICINE

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Language advisor: N.R. Khairullina, associate professor

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The problem of mortality due to cardiovascular diseases is relevant in Russian Federation. Ventricular late potentials (VLPs) could be classified as their predictors.

VLPs are low-amplitude, high-frequency signals that are located in late part of QRS complex. VLPs area in electrocardiosignal (ECS) is shown at Fig. 1.

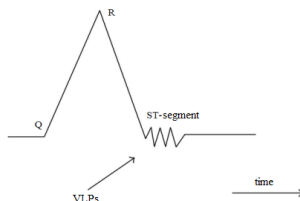


Fig. 1. Location of VLPs.

Registration of VLPs on standard electrocardiogram is difficult because VLPs amplitude is less than the level of high-frequency noises. The main method for VLPs registration is Simson method. It is based on time averaging of many cardiocycles. Within this method, the following parameters are analyzed:

- duration of the filtered QRS complex $Df_{qrs} > 120$ ms;
- root mean square amplitude of the last 40 ms of filtered QRS complex $RMS40 < 25 \mu V$;
- duration of low-amplitude (below $40 \mu V$) components in late part of filtered QRS-complex

$LAS40 > 39$ ms.

If at least two conditions are correct, a decision of VLPs presence in ECS is made [1].

Fig. 2a shows ECS recorded by three orthogonal leads X, Y, Z, Fig. 2b - averaged filtered cardiocycle by X, Y, Z leads.

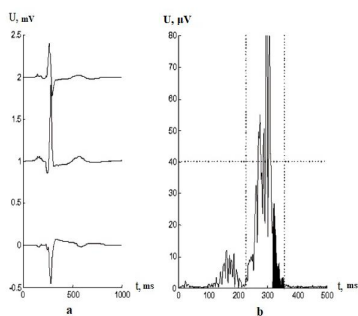


Fig. 2. Simson's method.

Petrov V.S. in article [2] considered Simson's method parameters changes in dynamics of time at people with rheumatism. As a result of 444 ECS analysis during 10 years, author notes that died patients had significant changes in VLPs parameters, and probability of sudden cardiac death increases along with Df_{qrs} increase.

In article written by Dushina A.G. and Libis R.A. [3] the analysis of ECS is performed by Simson's method. The study is made with the purpose to detect the presence or absence of VLPs within heart failure problem. Detection criteria were: $Df_{qrs} > 114$ ms, $LAS40 > 38$ ms, $RMS40 < 25 \mu V$. VLPs were registered in 10 patients (13% of cases). Average values of parameters in persons with chronic heart failure: $Df_{qrs} = 89$ ms, $LAS40 = 31$ ms, $RMS40 = 37 \mu V$. Thus, the Simson method is used to expand the range of diseases that may be associated with VLPs.

Another method for analyzing the presence or absence of VLPs is spectral analysis. Spectrum is signal representation in frequency domain.

Over the past few years in Russian Federation, spectral analysis of ECS registered by I standard lead (from hands) is developed due to scientists from Kazan National Research Technical University named after A.N. Tupolev - KAI. Sedov S.S., Shcherbakova T.F., Galimzyanov E.R. and Zaripov B.A. in article [4] considered the problem of VLPs registration in ECS by I standard lead. ECS analysis by this lead will increase capabilities of portable cardiac analyzers. Authors obtained ECS amplitude-frequency spectrum (using the fast Fourier transform) and analyzed it. As a VLPs detection criterion, authors designed a parameter that represents the ratio of spectrum's high-frequency components to low-frequency components. As a result, authors registered the biggest differences between the cases of VLPs presence and absence at 32 Hz frequency.

Sedov S.S., Shcherbakova T.F. and Mukhametzyanov O.A. in article [5] demonstrated the results of phase spectrum analysis. As a VLPs detection criterion, the authors designed a parameter that represents phase of ECS by I standard lead. Authors analyzed two samples: 50 and 80 records, half of them are VLPs presence cases. As a result, authors determined that, first, the threshold

parameters values changed insignificantly ($95,7^\circ$ and $98,6^\circ$) and, second, standard deviation increases along with sample increase. Thus, ECS spectrum analysis technique with the purpose to detect VLPs continues to develop in Russian Federation.

Third way to analyze VLPs presence in ECS is wavelet analysis. Wavelet is a mathematical function that allows to analyze various time-frequency components of data. Wavelet function is a wave-like oscillation. The term "wavelet" was firstly introduced in the mid-1980s by A. Grossman and J. Morlet within seismic signals analysis. The wavelet developed by them was named "Morlet wavelet" and it is shown at Fig. 3.

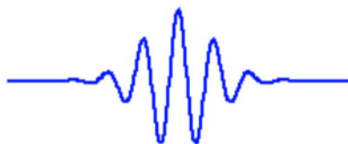


Fig. 3. Morlet wavelet.

Wavelet analysis objective in VLPs detection problem is to obtain a wavelet spectrum with its following analysis. Wavelet spectrum is three-dimensional figure: dependence of wavelet-transformed signal from frequency (scale change) and time (shift change).

We couldn't find the studies written by Russian Federation scientists over the past few years, which dedicated to wavelet analysis in VLPs detection problem. As a result, this field is developing poorly in Russian Federation. However, wavelet analysis in VLPs detection problem is actively developing abroad.

Based on analyzed material, we can form following conclusions:

1. The problem of VLPs registration in Russian Federation telemedicine is relevant today. Scientists continue to develop methods to register cardiovascular diseases predictors.
2. Methods for VLPs registration are developing both from technical field (digital signal processing) and medical field.

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УДК 378.14

DIGITAL EDUCATION: PROS AND CONS*Sagitov E.R.*

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The integration of digital technologies in learning now begins in elementary school, continues in middle school, high school, and, of course, in higher education. But the use of computer technology is not limited to the digital devices used, it includes anything that facilitates the interaction between teacher and learner. Digital education creates new opportunities for students learning in an online environment and for teachers, who can always change educational practices through hybrid courses, personalized learning, new collaborative models, and a wide range of innovative learning strategies.

One of the most important benefits of digitalization of education, experts say, is that students are not only thoughtful consumers of digital content, but also collaborative creators of effective digital media resources.

Learning Management Systems (LMS) such as Canvas, Moodle, and Blackboard allow for course management, homework and tests, tracking student grades and good/bad topics, which is a great collaboration tool for educators who want to get better results. For example, iClicker offers different sets of test assignments to be administered in real time, with automatic verification and comprehensive analysis.

Digital learning aids, such as Pearson, McGraw-Hill and Macmillan e-books, can be used to create learning resources and provide them to students.

Virtual classroom tools such as Microsoft Teams and Zoom are used for synchronous online lectures and allow participants to study in breakout rooms and "share their screen" with each other.

Remote proctoring software, such as Proctorio and Honorlock, helps maintain academic "honesty" by tracking and noting student behavior during tests that indicates poor performance.

Some instructors are turning to "gamification," which allows for interactive lessons and will reduce passivity in the classroom. This type of electronic technology brings healthy competition. Asynchronous learning provides a new level of flexibility for both students and teachers. For example, instead of waiting for students to show up in class, a work meeting can be set up using the Zoom platform and letting them know they are free to come in for a certain period of time. In addition, technology can be used for students to take asynchronous tests. This requires making the test available for 48 hours on the LMS platform, and students can take it at their convenience.

However, there is a need to identify a number of disadvantages of using digital technology in education.

By far the biggest problem with using technology in education is how distracting it can be. Games, videos, and music distract students from what they should be doing with digital technology as part of the learning process.

Another major problem is unverified information on the networks. Students, don't spend a lot of time searching for the right and reliable material, and often stumble upon incorrect data without even realizing it.

There is a widespread belief that digital technology interferes with students' professional development. Technology automates almost everything. The ability to learn, analyze, and apply one's knowledge in practice is often nullified when there is a gadget in hand. Students always find ways to cheat, and in the digital age it can be done even easier - from copying and pasting someone else's work into their own, to ordering ready-made work on the many websites that offer this service. However, it is possible to structure assignments and exams in such a way as to reduce the possibility of cheating to zero.

The use of digital technology has brought with it some data security issues. Their use may result in student information being available to a wider audience than anticipated. Along with this, remote proctoring programs can make test takers feel uncomfortable. Students do not always agree to be shown in front of a proctor at home, and therefore, being observed may increase their stress and anxiety.

It should be mentioned that not all students have equal access to technological resources, due to the lack of basic gadgets, or a stable connection over Internet.

Speaking of the educational institution itself, it is necessary to touch upon the not insignificant problem of the cost of providing the educational process with digital platforms. Often the purchase of the right to use them leads to enormous financial costs.

To summarize, it should be emphasized that, analyzing all the advantages and disadvantages of digital technologies, they should not be placed in the center of the educational process, so that they do not become an obstacle to quality and comprehensive education.

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УДК 621.3.05

TOPOLOGICAL INSULATORS

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Topological insulators are a new scientific discovery of physics in the 21st century. This discovery was predicted in 1987 by our compatriot Oleg Alexandrovich Pankratyev. The opening itself took place in 2007, in Germany, by Laurens Molenkamp. The advantage of this material is that they can significantly reduce the consumption of electricity in equipment, which in turn will help to reduce costs of electricity.

A topological insulator (TI) is a substance in which, due to the symmetry of the electron wave functions, the sample volume behaves like an insulator, while on the surface there are conducting surface (for a three-dimensional TI) or edge (for a two-dimensional TI) state. [1]

One of the main features of a topological insulator is the motion of its spin, due to this it can be represented as a top: during motion, the electron is rigidly bound to its spin and can change only if the surface of the material changes. And from this follows the next advantage of a topological insulator - electrons cannot be scattered by defects or other external influences. In turn, this leads to almost zero resistance of the medium. [1-4]

One of the brightest representatives of a topological insulator can be a connection of a graphene layer between two layers of hexagonal boron nitride. [5]

Unfortunately, the topological insulator also has disadvantages [1-5]:

- Weak theoretical base, due to the novelty of the research area
- High material cost

The paper discusses various ways of using topological insulators in live. The assessment of the effectiveness of their application has been carried out.

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УДК 336.74

PROSPECTS FOR THE DEVELOPMENT OF ELECTRONIC MONEY IN RUSSIA*Yamaltdinova N.F.*

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Prospects for the development of electronic money in Russia.**Introduction:**

Nowadays information technology has developed very fast. The Internet has become a global network for communication and informing users, it is an integral element in the field of payment for goods and services. It happened due to the growing people's needs of changes in the economy, scientific and technological progress, which led to a fast and efficient payment system. Electronic money and electronic payment systems have appeared.

Main part:

Money is a tool for managing the life of an individual and society as a whole. Money is a document that gives the right to receive any life benefits and property. It plays a huge role in the development of human society, regulate commodity relations in society and ensure the functioning of the economic system.

With the development of technology, more and more people are starting to use electronic money.

There is no exact legal definition of the term "electronic money". This concept applies to various payment methods used in practice, and these payment methods can be fundamentally different from each other.

The Electronic Money Report, published back in August 1998, provides the following definition: "Electronic money is broadly defined as the electronic storage of monetary value using a technical device that can and other firms and which does not require the mandatory use of bank accounts for transactions, but acts as a prepaid bearer instrument".

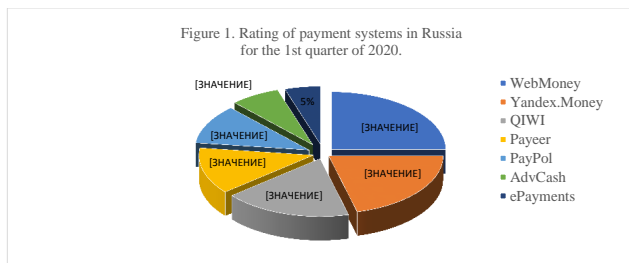
In September 2000, the European Union Directive 2000/46 / EC provided a clarified definition of electronic money: a monetary value, which is a requirement for an issuer, which:

- 1) is stored on an electronic device;
- 2) is issued after receiving funds in the amount not less than the issued monetary value;
- 3) is accepted as a means of payment not only by the issuer, but also by other firms.

The electronic money market in Russia is still at the development stage. Unlike foreign countries, Russian market began its functioning much later. Today, the leaders of the Russian electronic money market are WebMoney and Yandex.Money, with a combined share of about 46%.

Figure 1 shows a diagram characterizing the rating of payment systems in Russia for the first quarter of 2020. The most famous and frequently used server among users is WebMoney, which accounts for about 25% of the electronic money market. About 21% of residents of large cities

since the beginning of 2020, at least once made payments through Yandex.Money, through Qiwi-wallet - 18%, Payeer - 13%, PayPol - 11%, AdvCash - 7%, ePayments - 5%.



According to a Mediascope study, such an online payment method as electronic money is gaining more and more popularity every year. According to the research, in 2019 about 75% of the respondents already use it. The audience of electronic money services is growing rapidly and in 2019 compared to the previous year, their share increased by 31.5%.

Such growth of the electronic money market in Russia is a consequence of the influence of such factors as expanding the possibilities of using electronic money (improving the functionality of mobile versions, expanding the list of services), as well as the growing public confidence in non-cash payment methods. Electronic money has a number of advantages over cash:

- High portability - the value of the amount is not related to the overall or weight dimensions of the money, as is the case with cash;
- Very low cost of emission of electronic money - no need to print banknotes, use paper and paints;
- it is easier, than in the case of cash, to organize the physical protection of electronic money;
- Electronic money does not need to be counted, packaged, transported and organized in special storage facilities;
- Ideal preservation - electronic money does not lose its qualities over time;

The process of payment with electronic money is carried out quickly, there are no queues, there is no need to issue change, and money passes from the payer to the recipient quickly.

However, electronic money has its drawbacks:

- Lack of well-established legal regulation - many states, including Russia, have not yet decided on their unambiguous attitude to electronic money;
- Despite its excellent portability, electronic money needs special storage and handling tools;
- As in the case of cash, with the physical destruction of the electronic money carrier, it is impossible to restore the monetary value to the owner;

In addition, one of the problems in the development of the electronic money market in Russia is fraud. This problem can be solved by developing special legislation and standards that regulate activities in the field of electronic money, thereby ensuring the security and confidentiality of settlements.

It should also be noted that in Russia the legal problems regarding the safety of using electronic cash have not been fully resolved, the market for information security products is underdeveloped, and their import is not possible.

Problems in the development of the electronic money market in Russia are caused by both external (for example, a ban on the export of certain technologies to our country) and internal factors (licensing of imports or the absence of both reliable, convenient and adaptable domestically developed systems).

Conclusion:

Despite some moments that hinder the process of introducing a new type of payment, the development of electronic money in Russia also has its own perspective. With the growth of technology and the development of mankind, online payments will continue to evolve.

Almost all studies carried out in this industry indicate that in the near future electronic means of payment will completely displace cash from the market, since they represent a more convenient way to pay for goods and services. Online bill payment will reach significant volumes as the majority of users start using or increase their use of this payment option, along with a significant decrease in the use of "paper" payments.

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СЕКЦИЯ 3

АКТУАЛЬНЫЕ ПРОБЛЕМЫ ПЕРЕВОДОВЕДЕНИЯ

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УДК : 81'322.4

THE USE OF NEURAL ONLINE TRANSLATION TECHNOLOGY*Agafonov A.D.*Scientific advisor: G.R. Mullahmetova, PhD
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In this study we are trying to show the ways to improve online translations. This topic is quite relevant in our time, since a huge number of people use daily the global network and communicate with individuals from different parts of the planet. To facilitate the communication through the Internet, we need to take care of the quality of Internet translations.

Improper composed text can be the reason of many problems in translating. Firstly, one needs to make sure that the text does not contain spelling mistakes. It is advisable to simplify the text as much as possible, since complex and rarely used statements can complicate the translation. The main thing is to preserve the essence of the text and to follow strictly the order of its parts and sentences (subject, predicate, adverbs, circumstance, etc).

Each language has its own characteristics. Taking them into consideration is very important, since the lexical meaning of the text and the quality of the translation may depend on this.

In recent years online translators are trying to use the neural translation technology. This method has improved significantly the quality of translation in a short period of time. Better translations became possible due to the understanding of translation mistakes in a neural network. For example, Google, Yandex use this method of translation, since it is the most convenient and efficient one today.

The database also accumulates different types of translations, improves their subsequent quality, since the system remembers a more suitable translation and uses it in subsequent texts.

Several dedicated translators can be used to improve the quality of translation. After comparing the translations, it is necessary to compose the most correct option, since all translators have their own characteristics.

Homographs are also a big problem for translators. These are words that are similar in spelling, but different in pronunciation and meaning. To find out what this word means, the translator starts from the context, but this does not always come out correctly. To correct such mistakes in translation, it is better to increase the translation database and implement neural network technology so that the online translator will be able to cope with such difficulties.

To sum up, there are many ways to improve the work of online translators, from text preparation to neural online systems. Thanks to this the quality of translations are improving gradually every day.

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УДК 811.111-26

FEATURES OF ABBREVIATIONS TRANSLATION USED IN RESEARCH WORKS AND LITERATURE (THE SPHERE OF CONTROL AND COMPUTER SCIENCE IN TECHNICAL SYSTEMS)***Babina S.V.***

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An integral part of modern research works is the use of multiple abbreviations of words, special scientific terms, names of organizations, etc. An abundance of abbreviations is one of the striking characteristics of scientific and technical literature, which makes it important not only to compose and actively use abbreviated designations, but also to translate them from the original language. The skill of translating such lexical units is essential due to the fact that often in the process of learning or research, it becomes necessary to use literature in a foreign language.

Abbreviations of words are the omission of individual letters and syllables in a word, or the removal of part of a word. There are a lot of different kinds of classification of scientific and technical abbreviations. Most types of abbreviations are found in academic vocabulary as well as in informational texts and business communication. Consider common types of abbreviations:

- Initial. They are composed of the first letters or sounds of words that are included in the abbreviated phrase. The subtypes of this group include:

a) Letter abbreviations. They are characterized by the stress falling on the last syllable, and their reading in accordance with the pronunciation of English letters in the alphabet. For example, BBC (Би-Би-Си) - British Broadcasting Corporation. It should be borne in mind that in most cases, the periods after capital letters in the abbreviation are not done.

b) Sound abbreviations (acronyms). They are read like ordinary words, and the stress falls on the initial syllable. Example: laser - light amplification by stimulated emission of radiation.

- Syllabic (truncated). The use of such abbreviations is typical for special texts in English: telecoms - telecommunications, comp - accompaniment. These abbreviations do not have specific formation rules and can be:

1. Combinations of abbreviations with a whole word. This type of abbreviation is characterized by the replacement of a technical term with a letter and the use of a more common word entirely: e-mail - electronic-mail, H-bomb - hydrogen bomb.

2. Mixed abbreviations, which are formed when several of the above types are combined.

It is important to note that when the author or translator uses the abbreviated phrase for the first time, he should write it in full. Thus, the abbreviation can be indicated after decryption or before it. In addition, it is important to use articles correctly. They are put in if they refer to nouns following the abbreviation.

The features of the translation of abbreviations in scientific and technical literature are that the translation depends on the type of abbreviation. If the abbreviation is generally accepted, then there is an analogue for it in the target language, or it is translated by transliteration. The constraint is the fact that technical terminology is constantly being updated, and a situation, when the generally accepted abbreviation has not yet been recorded in special dictionaries, is possible. As about original abbreviations, it is important to indicate what one or another abbreviation means in order to avoid confusion [1].

Usually, an abbreviation in the context of a specific research or topic is unambiguous. However, it should be noted that there are abbreviations that, for different referents, have the same or approximately the same letter composition. This homonymy causes confusion and translation mistakes.

Referring to the sphere "Control and Computer science in technical systems", it must be kept in mind that students receive knowledge of automatic control theory, information technology and

professional programming. Thus, the program aims to prepare graduates to participate in the design, creation, and customization of control systems.

Consider the main abbreviations and ways of their translation from Russian into English within the framework of one of the key disciplines "Automatic Control Theory":

ТАУ - теория автоматического управления / Automatic Control Theory (ACT) is a generally accepted abbreviation;

ТС - техническая система / Technological system, the abbreviation has no analogue in English;

ОУ - объект управления / Controlled object, the abbreviation has no analogue in English;

УУ- управляющее устройство / Control device (CD);

СУ – система управления / Control system, the abbreviation has no analogue in English;

ИО – исполнительный орган / Final controlling element, the abbreviation has no analogue in English;

УО –управляющий орган / Control organ, the abbreviation has no analogue in English;

ОС – обратная связь / Feedback signal, the abbreviation has no analogue in English;

АФЧХ – амплитудно-фазовая частотная характеристика - Harmonic locus, the abbreviation has no analogue in English;

ЛАЧХ – логарифмическая амплитудно-частотная характеристика / Log-magnitude and phase diagram, the abbreviation has no analogue in English;

ФЧХ - фазо-частотная характеристика / Circuit phase response, the abbreviation has no analogue in English;

Within the framework of this discipline, the following dependence can be traced: the concepts that are used in the abbreviation form in Russian. in English are non-abbreviated terms. In support of this, two diagrams can be compared. The first one is the scheme of control system that is presented in the Russian coursebook [2] (Fig. 1). And the second one is the arrangement of the control system in the article in English [3] (Fig. 2). As can be seen from the figures, the first scheme is characterized by the preponderance of abbreviations and symbols, while in the scheme in English the terms are used in their full forms.

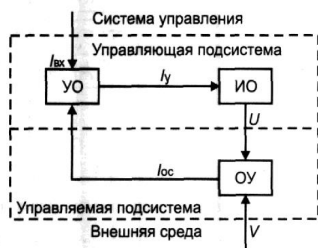


Fig. 1

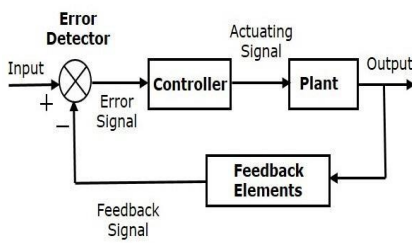


Fig. 2

Consider abbreviations in another fundamental discipline "Computer Science and Programming". In this case, most of the abbreviations come from English:

ANSI character set (American national standards institute) / Набор символов американского национального института стандартизации, (8-bit code table), the abbreviation has no analogue in Russian;

ASCII (American Standard Code for Information Interchange) / Американский стандартный код для обмена информацией, the abbreviation has no analogue in Russian;

СМЯК (Cyan-Magenta-Yellow-black) / Голубой-пурпурный-желтый-черный, (The color model that is used for displaying and printing color images, the abbreviation has no analogue in Russian;

CSS (Cascading Style Sheets) /Таблицы Каскадных Стилей, the abbreviation has no analogue in Russian;

FTP (File Transfer Protocol) / Протокол передачи файлов, the abbreviation has no analogue in Russian;

IRC (Internet Relay Chat) / Многопользовательская система общения, the abbreviation has no analogue in Russian;

IP (Internet Protocol) / сетевой протокол, (Network protocol is responsible for the transmission and routing of messages between Internet nodes), the abbreviation has no analogue in Russian;

W3C (World Wide Web Consortium) / Консорциум Всемирной паутины (World Wide Web Consortium is an organization that develops and implements technology standards for the World Wide Web), the abbreviation has no analogue in Russian;

PC (Personal Computer) / Персональный компьютер (ПК).

Therefore, in most cases, programming is characterized by the borrowing of abbreviations without their transliteration or other adaptation for the target language (in this case, Russian). This is clear, because the programming languages are based on English words as the main means of constructing program functions (for example, Switch - case statement in C, if - conditional statement in programming in C). In this case, the translator should either explain the abbreviations used by the author, or use them without explanation if they are generally accepted or sufficiently known to the reader of scientific literature on this topic. (for example, HTML, IP, e-mail, etc.).

In view of the foregoing, it should be noted that, during his work with a scientific and technical text, the translator needs to use knowledge of the basics of translation and also of the subject to which the translated text is devoted. Consequently, the translation of abbreviations is one of the most difficult to understand and translate elements of scientific texts.

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УДК 81.25

PROBLEMS OF PROPER NAMES TRANSLATION

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From ancient times humanity needed communication and cooperation. Sometimes communication was impossible due to the language barrier. With time this problem became less and less relevant because of development of trade relationships and colonial conquests. As a result, the spread of languages that are not indigenous in the area has increased. For example, in first case could be remembered the spread of the French language in Russia in the 18-19 centuries. In second case, could be remembered colonial conquests of the South America by European countries such as Spain and Portugal. Common nouns have different meanings and pronunciations in different languages, but proper names become something like a bridge to interlingual communication. Because whatever the name of your interlocutor, you will call him the same way in different languages.

But unfortunately, this created the idea that proper names don't require an attention when learning a foreign language. Even in textbooks they almost don't pay attention to them. Proper names often have cultural context, connected with other language units. That is why they require special treatment when translating. Because leaving proper name without adaptation will lead to its complicated identification.

On the one hand in linguistics it is considered that proper names related to a specific subject don't characterize it and do not provide any information about it. But on the other hand, due to the fact that proper names refer to a specific subject it gets subject's properties. Also, most of the proper names indicate the class the subject [1]. This explains the existence of toponym and anthroponym for example. At the same time part of its content become a message about its existence. At the moment in linguistic there are several principles of adapting proper names.

Transliteration is the principle of translation that based on preservation of the original spelling of the proper name. This principle is often practiced when translating languages using Latin alphabet. In the most cases proper names remain unchanged. Usually it is preferable to leave letters and signs inherent in to language from which the translation is made [2]. For example, polish name Walęsa is preferable to leave it in its original form. But the replacing the letters of the translated language with the letters of the Latin alphabet is also not a mistake.

But this principle has a disadvantage, for example, for a person who speaks only English, the name Mozart will sound like [mozat] but French pronounce it like [mozar]. If a native English speaker hears the French pronunciation, the native English speaker doesn't recognize it as something familiar. This can lead to misunderstanding.

As a result, the advantage of transliteration is in prevention proper name distortion, what allow anybody to identify proper names in the most cases regardless of language. The disadvantage is in ambiguity of pronunciation. There are pronunciation rules in each language for the pronunciation of foreign words. In adaptation from English to Russian is used in adapting company names (Apple, Google and Microsoft), newspaper editions (The Sun, The Times), in various abbreviations (UFC, MMA, NBA) etc.

The next one is transcription principle. It based on transmission of the original pronunciation and achieving phonetical proximity. At the moment it is the main adaptation principle from English to Russian language. The main goal of the transcription principle is to create correspondence between the original phoneme and the graphic equivalent.

But using transcription principle is not possible each time due to the transcription tradition and desire for euphonium. For example, proper names like Harry, Henrich, Manheim, Hugo. There is also a possibility for permutation of the stress sign, this happens due to the desire to maintain the inner rhythm of the Russian language, for example, Florida and Foresight.

In the modern practice the transcription principle is usually neglected in favor of the transliteration principle in some cases. This is for better identification of some words. For example, Harry Potter (doubled letters preserved in translation), Washington (letter "g" preserved), Texas (pronouncing x as h), Clinton (adding a neutral letter "o").

The advantage of transcription principle is the most pronunciation close to the original which brings the rhythm of the language into which the receiving language. The disadvantage is the complicated word identification, but this disadvantage is partially compensated by using the transliteration principle when necessary.

An important principle of translating proper names is also the euphony principle. In some cases, in the transcription of the word there are sounds that are letter combinations that are difficult to pronounce in the receiving language. For example, th (word "the"), we (word "Wembley"). Letter combinations like these often replaced by simplified and more familiar letters to the native speaker of the receiving language.

Thus, it is safe to say that translation of proper names is important and ambiguous topic which has been reminded in linguistics to these days. But over the time of translation practice many proper names translation principles have emerged. Every principle has weight in adaptation and its own application. Each specific case requires separate consideration. It is thanks to the scrupulous

approach that the word can left the characteristic features of the original and be convenient to be pronounced by the native speaker of the receiving language.

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УДК 802.0

DIFFICULTIES IN TRANSLATING NEOLOGISMS

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The main difficulty in translating neologisms is understanding the meaning of a new word [1]. The purpose of the study is to identify the features of the formation of neologisms found in online newspapers and social networks, as well as their translation from English into Russian. The actual translation of a neologism, the meaning of which is already known to a translator, is a relatively simpler task, and it is solved by using various techniques and methods of translation, depending on which type of words this neologism belongs to. There are no special techniques for translating neologisms. When working with neologisms, the translator has two possibilities to transfer these lexical units to another language:

- use the equivalent offered by bilingual dictionaries;
- offer your own translation option (in the absence of an equivalent fixed in bilingual dictionaries).

In a number of examples, we have the following:

Digital hangover - means a sense of shame that appears in a person who had great fun at a party yesterday, and today is watching "compromising material" on the Internet.

Digital detox – being tired of endless social networks and Google. You want to spend time in the real world, not the virtual one.

Pancake people is a generation of active Internet users who at first glance know a lot, but in fact all their knowledge is rather superficial.

Deskfast -breakfast eaten at one's desk at work.

Phone-yawn is a phenomenon when one person takes out a mobile phone to, for example, watch the time, as a result of which all the surrounding people also take out their phones. The "contagiousness" of this action is compared to yawning.

Guerilla proofreading is a thorough or rather meticulous search for errors in the text of messages and then publicly pointing them out.

Cyberstalking is a term denoting the process of virtual stalking or monitoring. In Russian, it is most often translated as "virtual persecution".

Child supervision is a phenomenon when children who are well versed in modern "gadgets" help parents in their use.

No less than in the technological sphere, neologisms appear in the household sphere. Here is a list of the most interesting and useful words on social topics.

Bromance - this word describes the close friendship of two guys of traditional orientation.

Facepalm is perhaps a well-known word that expresses a light slap on the face with a hand to express a whole range of emotions, from irritation to disappointment and even disgust. In Russian, we most often just say "facepalm", in some cases you can hear the expression "hand-face".

Dreamathon is probably a well-known term for everyone, it means the process when a person turns off the alarm several times, while seeing a new dream before each next call.

Chandelier earrings – we are talking about massive earrings made of beads, precious stones, etc. Earrings become so "complicated" that they resemble a chandelier.

Defensive eating – have you ever eaten something so fast that it didn't get to someone else? If yes, then you are familiar with the process of "defensive eating".

Frenemy is a term formed from the fusion of two words - friend (friend) and enemy (enemy). It means a person who pretends to be your friend, although in fact his intentions are far from friendly. Most often in Russian, the word "vrug" is used according to the same principle.

Staycation is another example of combining two words - stay + vacation (vacation), describes a case when a person on vacation does not go anywhere, but stays at home.

A large number of neologisms have no correspondences in dictionaries and become the object of the author's translation. The main problem of the translator is the transfer of neologisms that do not have correspondences in dictionaries. Here we will focus on the main difficulties encountered when working with lexical neologisms.

A significant difficulty for translation was made up of neologisms, the meaning of which is based on a certain image. An example of such an education is the following neologism: bank of mom and dad (a person's parents regarded as a source of financial assistance or support). When translating this English neologism, it was decided to choose a functional analogue in Russian. Taking as a basis the interpretation of the neologism in the English-English dictionary, we proposed the following option:

Parental support (the case when parents help their children financially). Despite the fact that the proposed version deprives imagery, it, in our opinion, solves the problem of the adequacy of the translation, since it conveys the meaning inherent in the English neologism. In the following example, the neologism was also created based on an image, in this case a fire hose. When selecting a functional analogue, the interpretation in the English-English dictionary was taken into account and an option was proposed: digital firehose (a very large stream of data) - digital stream (a large stream of information). In this case, the imagery was also not preserved during the translation.

So, the main difficulty in translating neologisms is to understand the meaning of a new word. The actual translation of a neologism, the meaning of which is already known to the translator, is a relatively simpler task, and it is solved by using various techniques and methods of translation, depending on which type of words this neologism belongs to. Let's formulate the main recommendations for the translation of neologisms.

1. Try to reveal the meaning of the neologism. The disclosure of the meaning of the neologism is carried out through:

a) using a dictionary. If a new word is missing in the English-Russian dictionary, you should try to find it in the English-English explanatory dictionary. As you know, in Webster's dictionary and in a number of other English-English dictionaries there are special sections "New Words" (New Words Section).

At the same time, one should strive to use the dictionary published in recent years, since the section of neologisms is usually significantly updated during reprints. Some new words can be found in dictionaries and sections dedicated to slang;

b) clarification of the meaning of the neologism from the context. Most often, the translator has to find out the meaning of a neologism from the context, using already known techniques. It is especially important to monitor the use of neologisms in context. Sometimes, in order to properly understand a neologism, it is necessary to take into account the history of its origin, various literary

and factual associations associated with a new word;

c) analysis of the structure of the neologism to clarify its meaning. New words in the language do not arise from scratch, they are created on the basis of already existing words and morphemes, often based on analogy. The analysis of the meaning of such words and morphemes can provide a translator with serious help in understanding the meaning of neologism. In order to be able to correctly analyze the structure of a new word, it is important for a translator to have a good command of the basic ways of creating words in English.

When deciphering the meaning of neoplasms in a language, it is often necessary to find out the meaning of a word from the context, it is also necessary to take into account its etymology, various literary and factual associations, structural and semantic features.

2. Check the proposed version for possible use by other translators, authors. Such a check is possible in any Internet search engine.

At the same time, it is important to introduce the proposed translation of the neologism in the context. So, there are no special techniques for translating neologisms. The specifics of translating each new word depend on what type of words it belongs to (terms, names, synonyms for words that already have correspondences in the language, etc.).

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УДК 347.78.034

FEATURES OF TRANSLATION OF ENGLISH NON-EQUIVALENT VOCABULARY INTO RUSSIAN

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At the moment, English, as well as many other languages, is experiencing neological abundance. New words in the rapidly developing modern civilization appear no less rapidly, reflecting in the language the need of society to express new concepts that constantly arise as a result of the development of science, technology, culture and social relations. The language is not a closed system, it is in the process of continuous development, which is largely due to the development of its word-formation system.

Often in the vocabulary of one language there is a lack of correspondence to the lexical unit of another language. In these cases, it is customary to talk about the so-called non-equivalent vocabulary. According to V. N. Komissarov, "non-equivalent vocabulary is found mainly among neologisms, among words naming specific concepts and national realities, and among little-known names and titles for which it is necessary to create occasional correspondences in the translation process" [3].

It should be emphasized that the term "non-equivalent vocabulary" is used only in the sense of the lack of correspondence to one or another lexical unit in the vocabulary of another language. But it would be wrong to understand this term in the sense of the "impossibility of translation" of this vocabulary. Any language can express any concept; the absence in the vocabulary of the language of a special designation for any concept in the form of a word or a stable phrase does not mean that it is impossible to express this concept by means of this language [1].

Currently, it is becoming obvious that the boundaries of non-equivalent vocabulary are much wider than previously assumed. Some of the non-equivalent vocabulary, while receiving stable

correspondences in translation, at the same time do not lose a specific cultural component, which is expressed in the connotative meanings of words that do not always coincide in different languages.

In the works of S. Vlahov and S. Florin, A. O. Ivanov, P. V. Chernov, V. N. Krupnova non-equivalent vocabulary is considered in connection with translation problems. One of the most important peculiarity of translation, currently recognized by the absolute majority of theorists, is that translation is an operation relative in its results. Indeed, in each language, in relation to any other, there are elements, the transmission of the meaning of which is impossible under normal conditions within the text itself. Such elements constitute in the language what can be defined as actually untranslatable. The absence of exact and permanent lexical correspondences to any word does not mean neither the inability to convey its meaning in context, nor its untranslatability in the future, however, there is a constant need to convey new words or new meanings already existing words. Any word can be translated into another language at least descriptively.

What is impossible with respect to a single element is possible with respect to a complex whole, i.e. with respect to contextual translation. So the question boils down not to whether it is possible or impossible to translate someone else's lexical unit, but to how to translate it. Opportunity correctly transmitting non-equivalent vocabulary and the concepts associated with it presupposes certain knowledge about the reality in which this vocabulary functions.

There are two main difficulties in the transfer of non - equivalent vocabulary in translation:

- 1) the absence of an equivalent in the translation language due to the absence of a foreign lexical unit of the subject for native speakers of this language;
- 2) the need, together with the objective meaning of the word, to convey its color, its additional shade, specific coloring.

Non-equivalent vocabulary, as a rule, causes the greatest difficulty when translating into a foreign language, since the dictionary translation of such vocabulary does not give results. An example of a special approach to the translation of non-equivalent vocabulary can be considered the translation of semantic lacunae [2], i.e. words that have no equivalents in the form of separate words. Such semantic lacunae in relation to the Russian language are the following English words like bouncer, glimpse, barber, etc. However, the fact that there are no separate words in the Russian language, attached to these concepts, does not mean that all these specifically national concepts cannot be conveyed in translation, at least by descriptive translation, which can be recognized as the main way of translating semantic lacunae.

One of the variants of non-equivalent vocabulary is words of broad semantics, which reveal a discrepancy of referential meanings in the PL in comparison with the IA, for example, iron –iron and iron, hand - arm, hand, translator - interpreter, translator. At the same time, the choice of the required correspondence in the translation of this type of non-equivalent vocabulary is possible only if you go beyond the linguistic context and know the real situation or situation itself.

A separate kind of translation difficulties is an alternative- equivalent vocabulary. This is a special kind of non-equivalent vocabulary, which includes proper names, the non-equivalence of which is due to the national identity of the language and culture of the people who speak it. As a rule, when translating proper names are borrowed by transcription - transmission of the sound of the proper name. However, in cases where the proper name does not just name the subject, but has some additional meaning, the mechanical transmission of the sound does not ensure the adequacy of the translation. The adequacy of the translation is achieved only by explication of the semantic structure, which, in relation to various types of proper names, has certain patterns.

As a separate group of non - equivalent vocabulary, A. O. Ivanov considers linguistic realities are special words and phrases naming objects characteristic of the life, everyday life, culture, social and historical development of one people and alien to another; being carriers of national and/or historical color, they, as a rule, do not have exact correspondences (equivalents) in other languages.

Another translation difficulty is the translation of such referentially non-equivalent vocabulary as complex words (job-getter, bread-winner). Most complex words rarely get into a bilingual dictionary. So, out of 340 compound verbs marked in the 3rd In the edition of Webster's Dictionary, only 194 are presented in the NARS, translated, as a rule, descriptively. As for words-phrases

(can't-do-it-a-thing, a shoot-to-kill (order)), the Anglo-Russian dictionaries are included only few, because they are unstable, extremely occasional active entities that don't go in at all and usage dictionaries simply do not have time to fix them. The difficulty of translating them is not so much in understanding how much is in finding a way to express this meaning in Russian [2].

In general, the translation of all types of non-equivalent vocabulary is considered an extremely difficult problem, since the translator always faces the problem of choosing between calculus and explanatory, descriptive translation. The preservation of the inner form can lead to a violation in pragmatics, and the preservation of pragmatic meaning can be accompanied by the loss of reference, i.e. a certain part of the meaning. This choice cannot be fixed by some universal translation norm, but is based only on the degree of skill and taste of the translator.

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PROBLEMS AND FEATURES OF TECHNICAL TRANSLATIONS

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The research made depicts the features and problems of technical translation, the causes of mistakes and their prevention.

Technical translation is one of the most important areas in modern translation practice and is one of the most difficult areas in translation studies. Complex due to the fact that it has many different requirements. Technical translation refers to the translation of a text that has a large number of terms, often it may be incomprehensible to non-specialists. The task of a technical translator is to take into account terminology, convey information in another language that is contained in the text. A high-quality translation of a technical text is a text that has maintained the style of the original document and conveyed reliable information when reading. It also requires the translator to have knowledge of the topic in the field of translation and terminology. When translating the text, some terms may have several meanings, if the document is misunderstood, then, for example, an agreement in which the interests of different parties are expressed may be terminated.

Technical translation has its own number of features:

- 1) It should convey clearly the meaning of the original text. Deviations are allowed if this is required due to the peculiarities of the language.
- 2) It is always a formal style, possessing impersonality and lack of emotions.
- 3) Only generally accepted grammatical structures are allowed to use.
- 4) The absence of a predicate or subject and a large number of enumerations.

Technical translation is a combination of linguistics and science, its complexity is the combination of these two areas. Professional translators use specialized dictionaries for high-quality translation, since in the modern world terms from some areas can flow into other areas of activity.

Also, the difference in the requirements for abbreviations and the difference in standards may become a problem.

The correct translation may be hindered by the fact that terms may have can be synonyms: the same concept can sometimes be denoted by different words: screen - shield (экран), so it is important not to forget to look at the context, and abbreviations, for example, which have one additional letter at the end: subq – subcutaneous (the letter "q" is missing in the full word), complex: *CHD – congestive heart disease or congestive heart disease or coronary heart disease*, multi-valued: *sub-subaltern, subeditor, subject, subjunctive, sublimation, submarine, subscription*. Technical texts can contain the lingo that cannot be found in dictionaries, because of this it is important to pay attention to the context that restricts terminology. But even if the translator finds a suitable technical meaning in the dictionary, due to the lack of narrow technical dictionaries, the found meaning may not have a contextual meaning. This will also cause problems in translation, words in a technical text may acquire different meaning, for example the word *goose* can be translated as *ymoz*.

Thus, we can conclude that technical translation is a painstaking, but at the same time in-demand occupation, which has a lot of its own features and problems. Also, technical translation is the application of a whole range of knowledge, ranging from linguistic to highly specialized. Only a good translator who has the flexibility of thinking and special knowledge can make a high-quality translation that meets all the requirements. Technical translation contains many features, such as the transfer of ideas of the original text, formal style, generally accepted grammatical structures. There are also problems: difficulty in deciphering different abbreviations, terms that have the property of synonymy.

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LEXICO-PHRASEOLOGICAL FIELD "MORALITY" IN THE WORK BY F. BURNETT "THE LITTLE LORD FAUNTLEROY" AND ITS TRANSLATION N.M. DEMUROVOI: COMPARATIVE ASPECT

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The most important factor in the development of human society is the relationship between language and culture. Various forms of all specific and original features are reflected in the language of any nation. The specific features of the mentality, first of all, are expressed in the lexical system. Consequently, the importance of diverse language's lexical system's comparative research for a deeper foreign culture's understanding takes place.

This work is devoted to the comparison of lexical and phraseological units in the work of E.F. Burnett "Little Lord Fauntleroy" [4] and in its translation into Russian language by the modern philologist and translator N.M. Demurova [2].

The aim of the work was to make a comparative analysis of the semantic field's content

that the translator represents. The task of accurate translation is a more complete acquaintance with the culture.

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THE HISTORY OF PHILOLOGY (INTERDISCIPLINARY RESEARCH)

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The research deals with philology as a special field of knowledge that studies works of oral and written creativity, examines the manifestation in texts of the spiritual and mental component of a particular people or a particular writer. The paper considers the history of the emergence and formation of philology as a science, and determines its significance in the modern world.

“In the beginning was the Word, and the Word was with God, and the Word was God” [1] – begins the Gospel of John. In this first verse, the Word has a special role to play. It is independent, objective, absolute, and does not obey either space or time. All life begins with it. In this sense, the word becomes synonymous with wisdom. In a prayer address to God, only a certain set of words is used, which are also arranged in a certain sequence. It is believed that the thoughtful reading of prayers aloud creates a special state in the human mind, which is recorded even by special technical devices.

Since ancient times, people have given the word a special role. Evil words spoken with hatred, wishing for misfortune, were considered a real curse. Conversely, affectionate words spoken with love, with a wish for peace and kindness, could inspire a person to do things, cheer them up at the right moment. It is no coincidence that the poet Vladimir Shefner wrote: “With a word you can kill, with a word you can save, with a word you can lead a regiment” [1, p. 248].

At the end of the third and beginning of the first century BC the science of “philology” (literally “love of the word”) appeared in the depths of Greek philosophy. The very first philologist is called the ancient Greek scholar Eratosthenes (late III-early II centuries BC). He studied poetry, grammar, and rhetoric.

Scientists of Ancient China, India and Egypt made a great contribution to the development of philology as a science. Poetics was born in the bowels of these countries. The Chinese from the East studied the written text and created libraries, the largest of which is the Library of Alexandria. In addition, philologists of that time devoted a lot of effort to learning. Reading courses and analysis of poetic works were particularly popular. Later, within the framework of philology, separate independent professions began to appear, such as librarian, interpreter of texts, teacher of literature, translator.

In the Middle Ages, the so-called “classical philology” emerged in Europe, which absorbed the

traditions of antiquity. The subject of the study was the life, literature, history, philosophy and culture of Ancient Greece and Ancient Rome.

A separate major area was the study of Biblical texts. Within the framework of this study, two areas emerged: biblical criticism, which dealt with the question of the authorship of Biblical texts, and exegesis, which, in turn, dealt with the interpretation of Biblical texts.

In the XVI-XVII centuries, the countries of Asia and Africa were colonized and actively settled by Europeans. Philology of this period is closely connected with the study of the languages of various peoples, and later with the study of their traditions, culture, beliefs and way of life.

Due to the emergence of interest in national languages and national culture, many theoretical aspects of philological science were significantly improved. French scientists Antoine Arnaud and Claude Lanson developed a comparative direction. So, they created a grammatical description of languages, which is based on their generalities. The researchers proved the idea by comparing classical languages (ancient Greek, Latin, and Hebrew) and modern languages (French, German, Italian, Spanish, and others).

In the late 18th and mid-19th centuries, the features of modern philology began to take shape in Germany. This was due to the need to unite people, which in turn inevitably contributes to philological sciences. The study of the spiritual culture of people, their literary and cultural heritage aroused great interest. At this stage, the names of such scientists as F.A. Wolff, A.A. Beck, F. Schleiermacher are to be mentioned. The founder of modern philology is called the German scientist Friedrich August Wolf, who for the first time in history, when entering the university in Göttingen, called himself "philologist student". During this period of time, philology as a science once again began to develop in two ways at once. The first way is to study national languages (German, Slavic, Iranian, and others). This is how Slavic philology and Germanic philology appeared, for example. The second way is to develop comprehensive knowledge, such as folklore studies, linguistics, and literary studies. Both of these areas developed rapidly.

In the middle of the XIX century, the comparative-historical paradigm began to dominate in science. At this time, linguistics was separated from philology and became an independent field of knowledge. In this direction, scientists such as Jacob and Wilhelm Grimm, famous not only for their fairy tales, but also for serious scientific works, Ferdinand de Saussure, Alexander Vostokov and others. All of them studied first of all the structure of the language.

However, at the beginning of the twentieth century, the comparative-historical paradigm was replaced by the cognitive paradigm. In this case, first of all, the Author - the Creator of the text - is put at the head of philological science. Various types of concepts – "clots of the spiritual culture of people", as Yu.S. Stepanov very accurately called them - were actively studied [2]. And also, the study of the language picture of the world of a particular writer has become very popular. Text analysis began to be performed at all levels at once and thus became complex.

Thus, in modern philological science there is a close interaction between linguistics and literary studies, and new related fields of study are emerging.

As for the structure of philological science, it is extremely extensive. It is represented by four large directions:

1. Classical Philology. It includes Old Testament Literature, Byzantine Studies, Hebraic studies, Greek studies, Latin studies, Etruscan, studies and medieval literature.

2. Modern Philology: American and Latin American Studies, English studies, Balkan studies, German studies, Slavic studies, Scandinavian studies, etc. (13 in total).

3. Oriental studies, Asian studies and African studies: philology of ancient languages of the Middle East, Arabic studies, Egyptology, Tibetology, Japanese studies, etc. (18 in total).

4. Philology of Australia and Oceania.

Currently, the status of philology as a fundamental independent science is very high. Philology is one of the areas of specialist training in many higher educational institutions. The demand for a qualified philologist is very high. At the same time, the requirements imposed on the future specialist are also growing. To date, it is not enough just to be able to read and understand the text. It is also important to have extensive knowledge in the field of foreign languages, to have a good

understanding of fiction, both domestic and foreign, to have a high level of rhetoric and oratory skills, as well as to have skills in working with virtual text [3].

The entry of philological science into the virtual space is to be considered separately. All sorts of gadgets are the main way to get information today. Millions of texts on various topics are uploaded to the Internet every day. As a rule, all of them are accompanied by additional advertising texts. It is no coincidence that one of the most popular professions today is the profession of copywriter (literally "text creation"). Copywriters are yesterday's graduates of philological faculties, professional philologists who can and are able to work with various types of texts.

Many public figures, scientists and politicians have repeatedly expressed their opinion about the devaluation of the Word in the modern world. Now it is rare to meet a connoisseur of the Church Slavonic language or a person who can read Sophocles fluently in the original. Virtual language, simplified and primitive, often contributes to the neglect of the word and the language as a whole. It forms a nation of poorly read, illiterate people, for whom philology as a science is increasingly beginning to resemble an incomprehensible and specific field, like ancient scholasticism. The creators of virtual texts themselves strongly disagree with this. Famous copywriting guru David Ogilvie wrote: "No one considers the printed word evil just because it brings pornography to light. But it's also thanks to it that you are holding the Bible in your hands" [4].

Thus, the transition from the real world to the virtual is quite expected stage in the development of modern philological science. And only time will tell how it will develop further, which path it will take.

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DIFFICULTIES IN TRANSLATING THE PHRASEOLOGICAL UNITS WITH NUMBERS

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Speech has long been an integral attribute in a person's life. At the moment, there are many countries, cultures and languages. Over time, with the development of speech, stable expressions began to form in languages, that is, combinations of words that carry a certain meaning. These expressions became fixed in the language, they began to be called phraseological units. When translating from one language to another, the meaning of a stable expression may be lost.

Phraseological units serve to make speech expressive. They allow the speaker to express his thought accurately and subtly. However, it is worth noting that phraseological units are a unique particle, and, in some cases, seem absurd. Therefore, we carried out a research and found out what difficulties people face in translating phraseological units with numbers, when translating a stable expression with numbers from Russian into English.

We took five Russian phraseological units and found out how much the meaning of the fixed expressions would be distorted while using five online translators:

- 1) Google Translator
- 2) Yandex Translator
- 3) Bing Microsoft Translator
- 4) Systran
- 5) Prompt

The first phraseological unit is "Два сапога пара". The meaning of this stable combination can be interpreted as follows: "One is similar to the other", "One is not better than the other."

It is translated as follows:

- 1) Google Translator: Two a kind.
Reverse translation: Two identical objects / Два одинаковых предмета
- 2) Yandex.Translator: Two pair of boots
Reverse translation: Two pairs of boots / Две пары ботинок
- 3) Bing Microsoft Translator: Two pair boots.
Reverse translation: Two pairs of boots / Две пары сапог.
- 4) Systran: Two pair boots
Reverse translation: Boots with two pairs/ Сапоги с двумя парами.
- 5) Prompt: They make a pair.
Reverse translation: Two boots - a pair / Два сапога – пара

Thus, when translating the phraseological unit: "Two boots of a pair", The best result was shown by Prompt, it translated this stable expression accurately. The other four translators have distorted the meaning of the phraseological unit.

The second phraseological unit is "Смотреть в оба". The meaning of this phraseological unit can be interpreted as follows: "Be very attentive". This stable expression is translated as follows:

- 1) Google Translator: Look at both.
Reverse translation: Look at both / Посмотрите на оба
- 2) Yandex.Translator: Keep your eyes open.
Reverse translation: Keep your eyes open / Держи глаза открытыми
- 3) Bing Microsoft Translator: Look at both.
Reverse translation: Look at both / Посмотрите на оба
- 4) Systran: Watch both.
Reverse translation: See both / Смотреть оба
- 5) Prompt: Be on guard.
Reverse translation: Be on your guard / Будьте на страже

When translating the phraseological unit: "Смотреть в оба" the best result was shown by Yandex.Translator.It introduced better the meaning of this stable expression. It is worth noting the Prompt-translator which conveyed correctly the meaning of the original expression.

The third phraseological unit is "Палка о двух концах". The meaning of this phraseological unit can be understood as follows: "Something that can have both positive and negative consequences." This stable expression is translated as follows:

- 1) Google Translator: A double edged sword.
Reverse translation: Double-edged sword / Обоюдоострый меч
- 2) Yandex.Translator: A double-edged sword.
Reverse translation: Double-edged sword / Обоюдоострый меч
- 3) Bing Microsoft Translator: The double edged sword.
Reverse translation: A double-edged sword / Двусторонний меч
- 4) Systran: Double-edged sword.
Reverse translation: A double-edged sword / Палка с двумя концами
- 5) Prompt: Two-edged sword.
Reverse translation: Double-edged sword /

The best result, when translating the phraseological unit: "Палка о двух концах," was shown by the online translator Systran. The complete meaning of stable expression is lost when working with Bing Microsoft Translator .

The fourth phraseological unit is “Семеро одного не ждут”. The meaning of this expression can be understood as follows: “Several people should not suffer because of one.” This stable expression is translated as follows:

1) Google Translator: Seven do not wait for one.

Reverse translation: Seven do not expect one / Семь не ждут одного

2) Yandex.Translator: Seven are not waiting for one.

Reverse translation: Seven do not wait for one / Семеро не ждут одного

3) Bing Microsoft Translator: Seven one are not waiting.

Reverse translation: Seven one does not wait / Семь один не ждёт

4) Systran: Seven can't wait for one.

Reverse translation: Seven cannot wait for one / Семь не могут ждать одного

5) Promt: The majority rules.

Reverse translation: Majority principle / Принцип большинства

With the translation of the phraseological unit: “Семеро одного не ждут”, four translators coped with. Promt translated this phraseological unit inaccurate, however, in our opinion, it conveyed correctly the meaning of the stable expression.

The fifth expression is “На первый взгляд.” This one can be understood like this: “At first impressions.” This phraseological unit is translated as follows:

1) Google Translator: At first sight.

Reverse translation: At a glance / С одного взгляда

2) Yandex.Translator: At first sight.

Reverse translation: At a glance / На первый взгляд

3) Bing Microsoft Translator: At first glance.

Reverse translation: At first glance / На первый взгляд

4) Systran: At first glance.

Reverse translation: At first glance / На первый взгляд

5) Promt: At first sight.

Reverse translation: At a glance / Спазы

In our opinion, all online translators have done an excellent job of translating the phraseological unit: “На первый взгляд”. There were slight differences in translation, but the essence remained the same.

In conclusion it can be highlighted that five Russian phraseological units with numbers were translated into English with the help of five online translators. In the process of translation, the essence of the original fixed expressions changed. After doing the research, we found that there are no perfect online translators. There is much work to be done while improving the functions of online translators.

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TYPICAL PROBLEMS AND FEATURES OF SCIENTIFIC TEXT TRANSLATION

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In the modern world of globalization and intercultural communication, the expansion of international relations, trade, financial and economic ties between countries, the strengthening of the integration of European states and the whole world, the development of science and technology,

the constant exchange of scientific and technical information enhances the importance of a foreign language as an effective factor of economic, scientific, technical and cultural progress, as a means of oral and written communication between representatives of different peoples and cultures. The modern era of scientific and technical transformations covers all aspects of the existence of modern society, and in the changed economic conditions with the highest level of development of modern technologies, there is a special need for specialists - translators with practical skills in translating scientific and technical texts related to various fields of knowledge; therefore, the need for such specialists is of particular relevance.

Thanks to modern technologies, especially communication tools, which help scientists from all over the world to instantly exchange information and conduct joint research, modern science has managed to achieve unprecedented results. In such conditions, the need for high-quality translation of scientific literature has significantly increased. A translator of scientific literature should constantly improve his vocabulary, understand the terms and know their meaning.

According to A. L. Pumpyansky, "Translation of scientific and technical literature is a special discipline that arose at the junction of linguistics, on the one hand, and science and technology, on the other. Therefore, the translation of scientific and technical literature should be considered both from linguistic and scientific and technical positions, with the primacy of the former in the study of general language issues and the latter when considering narrow terminology" [1, p. 25].

Translation of scientific and technical texts must meet the following requirements: equivalence, adequacy, information content, consistency and clarity of presentation. For the translation of a scientific and technical text to be adequate and equivalent, that is, high-quality, the translator needs general and specific skills, abilities and the following knowledge: theoretical - about the phonetic, lexical and grammatical structure of a foreign language (lexical units, grammatical rules, word formation); practical - about the features of the translation of scientific and technical texts (types of translation transformations and correspondences); linguistic practical knowledge (methods of translation: transliteration, tracing, replacements, rearrangements, additions, omissions, methods of descriptive and antonymic translation); extralinguistic knowledge (possession of sufficient information to translate a specialized text) necessary in the process of translating the text and constructing meaningful and adequate sentences in the target language. [2, p. 56].

In this article, we will try to analyze the features of a scientific text and the difficulties that a translator may face when working with it, the basic requirements for scientific translation, as well as those translation techniques that can be used to achieve a better result.

First of all, it is necessary to get an idea of what "scientific translation" is, what are its differences from literary and other types of translation. The scientific style includes a wide range of research texts - from abstracts, abstracts and reviews to articles, theses, dissertations and monographs. Important conditions to consider are: purpose, style, organization of the text and the relationship between its parts.

In addition to the external organization of the academic text (chapters, sections, paragraphs), there is its internal organization. A characteristic feature of the organization of a scientific text is from general to specific, as well as the presentation of material in the form of a problem and a solution. To connect parts of the text, as well as a smooth transition from one statement to another, there are a number of words and expressions that are used for different purposes: additions (in addition, moreover, furthermore ...); oppositions (although, however, despite, in spite of, nevertheless ...); expressions of cause and effect (therefore, as a result, due to, because of ...); clarifications (in other words, that is, i.e., for example, for instance ...) [3, c 31].

Terminology. Since the leading form of scientific thinking is the concept, almost every lexical unit in a scientific text is expressed by special lexical units - terms. Term - designating a word or phrase characteristic of a given branch of science and technology. Has clear semantic boundaries. Accordingly, terminology is a system of concepts of a given science, enshrined in the corresponding verbal expression. If in a common language (outside of this terminology) a word can be polysemantic, then, falling into a certain terminology, it becomes unambiguous, and the translation uses a meaning that is different from that used in everyday life. Therefore, the main mistakes that a

translator can make when translating a scientific text are associated with unwillingness or inability to use the dictionary and, no less important, misunderstanding of the subject situation - ignorance of what the term means, even in the native language. In quantitative terms, in the texts of the scientific style, terms prevail over other types of special vocabulary (nomenclature names, professionalism, professional jargon, etc.); it is a vocabulary used in scientific texts of all fields of knowledge (classification, analysis, structure, function; component, result, factor, assessment). On average, terminological vocabulary reaches 20% of the entire vocabulary of a scientific text.

The transformational theory (model) of translation is based on the fact that translation activity is based on the transformation or transformation of the original text into the translation text. This model is associated with the ideas of "transformational or generative or generative grammar" by the American linguist N. Chomsky. Within the framework of this theory, the process of creating a translation text is considered as a syntactic transformation of units and structures of the source language (IL) into units and structures of the translating language (TL), while significant attention is paid to the stages and techniques of the translation process. This theory developed mainly in the works of the American translation theorists Yu. Naida, B.O. Kade, W. Koller. The ideas of transformational theory make it possible to discover translationally correlated structures and translation units that interact in the process of translating pairs of languages.

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BASHKIR PHRASEOLOGICAL UNITS. TRANSLATION OPTIONS

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The study of phraseology in Russian linguistics began in the time of M.V. Lomonosov. At that time and throughout the 19th century phraseology was considered as an object of lexicography in connection with the interpretation of the meanings of phraseological units and the disclosure of their meanings. Considerable work has been done in the field of Turkic phraseology. The creation of the first phraseological dictionaries of specific Turkic languages contributed to the accumulation of phraseological material and its initial systematization. However, none of the Türkic peoples have special dictionaries that would fully reflect the phraseological richness of a particular language.

In Bashkir phraseology, the life experience of the people, obtained in various situations, was fixed. According to our observations, it was revealed that phraseological units in Bashkir-Russian phraseological dictionaries are translated into Russian using semantic, lexical, literal, in some cases combined types of translation.

Semantic translation is necessary when interpreting phraseological units that have secured the phraseological interpretation of any relevant and informatively significant objects and concepts.

Lexical translation is carried out using the selection of lexical synonyms, using the selection of synonymous word combinations. It is usually used to translate phraseological units that are

transparent in semantics, expressing a concept that is transmitted into Russian by a word or phrase, for example: бопсак сӘсәй (lit.: sow peas) - to show off.

Literal translation is used very rarely, for example: ҮЗ КӨСӨ МЕНӘН – on their own

The combined method is most often used in dictionaries. The translation is done descriptively and simultaneously using a synonym or synonymous phrase, for example: ике тӘкӘ башы бер казанға һыймай (literally: two ram heads do not fit into one pot) - not get along with anyone, not be able to live together.

Thus, summing up the study of Bashkir phraseological units, it can be noted that the most common type of translation is the lexical approach. There is also a combined type of translation. It is considered the most expedient in the transfer of specific features of phraseological units.

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SLANG IN ENGLISH SONGS. HOW TO TRANSLATE?

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English is the most widely spoken language in the world. Many people who learn English often have difficulty learning the language. In particular, these difficulties arise with English slang. It can be heard in songs, in cafes, shops and almost everywhere. Also, slang is quite common in the Internet. Using slang, a person shows his belonging to a certain group of people and also emphasizes uniqueness. Slang is a series of words and expressions that originated in a separate group of people. English slang is interesting and at the same time difficult because it can vary even within the same city from district to district. How can an English learner understand slang and use it easily in appropriate situations? As it was mentioned above, slang is found in both writing and speech. Most of all we are interested in slang in the music industry. Slang is more common in hip-hop songs than in other genres. To understand what exactly the rapper meant by using a slang word, you need to pay attention to many factors. For example, a slang word that is often used in hip-hop music, "Ice" literally translates as "Ice", and in slang means "expensive jewelry", mainly diamonds, which are similar to ice in their shine. Another interesting word "Slime" (Slime) is literally translated as "Slime", but in slang it means "a close friend", "brother".

Also, rappers can use slang abbreviations, for example, to show their respect and love to close friends and brothers, rappers use the abbreviation "SLATT" (Slatt). It stands for "Slime Love All The Time", which means "Love to all my brothers always."

There is a very useful site "Urban Dictionary", which contains, if not all, then certainly most of all slang expressions with explanations and examples of use. And every new slang expression is added to the site gradually. We recommend this site to all English learners who want to understand what a rapper is reading about in a track. Slang is also common on the Internet. People often use abbreviations that can cause difficulties for a person learning English. For example, on the Internet you can find the abbreviation "PLS", which means the word "please" and is translated as "please". "IDK" means "I don't know". Most often, such abbreviations are used to save time. For example, the expression "ASAP", which is often used in business English, means "as soon as possible", but in hip-hop songs it means "Always Strive And Prosper" and is translated as "Always strive and prosper". And there are a lot of such examples of identical slang expressions but with different meanings and translations. Therefore, it is important to know, when and by whom the expression was uttered in order to understand the person.

There are slang expressions that have bad meanings or that can be only used by certain people.

For example, black people use some slang expressions when referring to each other, and these expressions can have both positive and negative meanings. But if a white person uses these expressions, then it will be offensive to black people. Therefore, it is also important to know when and which slang expressions can or cannot be used.

By the way, in messengers we can find interesting slang abbreviations that use numbers. For example, the expression "CUL8R" stands for "See you later" and means "See you later." The pronoun "You" is often replaced by "U". To say "I love you" the abbreviation "Ly" is used, which stands for "love you". To ask the interlocutor "Can you talk?", a person can use the expression "RUF2T?", Which stands for "Are you free to talk?".

To understand the meaning of such expressions, it is necessary to pronounce a separate letter and number. Also, abbreviations of words are often used in English. For example, "sis" is derived from sister, "doc" is derived from doctor, and so on. To understand these abbreviations, it is desirable to understand how such abbreviations are formed. Most often, the word is abbreviated to the end of the word, and therefore, mastering the context of the expression, a person can easily understand who or what it is about.

Thus, there are a lot of slang expressions in English that should not be feared. It is important to understand when and where to use slang and when to refrain. Learning English slang is easy. For example, we should listen to western hip-hop, translate texts using the Urban Dictionary website. Also communication on the Internet helps in learning English slang.

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THE PROBLEMS OF TRANSLATION IN THE WORKS OF ENGLISH SCIENTISTS OF THE 20TH CENTURY

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The facts have proved that the 20th century was marked by a large number of translations, which allowed the development of theoretical expressions in this area. The main works of translation theory appeared in the second half of the twentieth century. The Art of Translation by T. Savory (London, 1952) occupied a special place at the early stage of theorizing, that is, in the 1960s. In the field of translation theory, adjectives of a strictly scientific nature are used in research in natural linguistics. This prestigious school English course has made a great contribution to the development of translation as the linguistic basis of special bilingual science.

M.A.K. Halliday emphasized the need to integrate translation issues into linguistic research and to consider translation theory as part of comparative linguistics. In his main works ("Comparison and Translation", "Comparison of Languages"), this scientist assumes that translation is the basis of any comparative study of linguistic units and structures, which involves ensuring the contextual equivalence of comparison units. Halliday believes that mutual relations are a feature of the source and target texts in general, but this is relativity. Halliday considers the concept of equivalence as a context and is not directly related to the use of any grammatical structure or lexical means, therefore it cannot be measured, that is, it cannot be strictly defined. This is considered a fruitful idea of an equivalent scale. The author identified two main stages: 1. The selection of the most probable equivalent for each category or division; 2. Changing this selection at a larger unit level.

The idea of the creation of the first linguistic monograph on translation belongs to the English linguist John Catford. This is the "linguistic theory of translation", which puts forward the most complete concept of language translation. Catford pointed out that before considering translation issues, we need to present the original common language concepts (Chapter 1). The second chapter defines translation and proposes a classification of translation types. Chapter 3 reveals a key term in translation theory - equivalence. It is important to determine the nature of translation equivalence, as well as the conditions and methods of achieving it. Scientists distinguish between possible types of translation: on the one hand, full translation and partial translation, on the other hand, full (translation at all language levels) and limited translation (only at one level). Catford proposes to establish the equivalence of two pieces of text based on experience, analyze the source text and the translation, and prioritize functional equivalence.

Peter Newmark is the author of numerous articles, translation textbooks and the monograph *Approaches to Translation*. This is a practicing translator and translation teacher. It suggests that there is an indispensable link between translation theory and translation practice, and emphasizes the application of translation theory. Its main provisions should be based on practice and accompanied by illustrative examples. Newmark developed two general translation methods - communication (equally influencing the original and target readers) and semantics (conveying the exact contextual meaning of the original within the translation culture), and pointed out their frequent combinations and interactions. More importantly, Newmark considers semantic translation, emphasizing the obligatory fidelity to the original text.

The philosophy of integration by M. Snell-Hornby is presented in her monograph "Translation Studies. An Integrated Approach" (1988). She presented her own model of the topic of translation research, highlighting six levels that make up a scale of interrelated and transitional elements (see: Komissarov 2001: 195-197). The author pointed out that in translation Taking into account the importance of ethnic and social cultural differences, as well as the need for cultural transfer and adaptation in translation, she also discusses in detail the issues of literary translation theory, emphasizing the vitality of the correlation between the source text and the target text.

A.D. Schweitzer is much relieved by the so-called translation of newspaper news. In 1973 he published the book *Translation and Linguistics*. Particular attention is paid to the functional functions of the translated language. In the Semantic Problems of Translation section, Schweitzer explores the use of grammatical transformations, the interpretation of lexical syntax and the contextual model of translation, stylistic and pragmatic issues of translation.

In 1988, his new book "Theory of Translation: Status, Problems, Aspects" was published, which is more theoretical in nature. The status of translation theory is determined within the framework of linguistic methods related to contrastive linguistics. The sociolinguistic aspects of translation and translation capabilities are studied in detail. Having established a connection between the theory of translation and linguistics and semiotics of the text, the scientist determined the basics of translation equivalence on the basis of three levels of semiotics: syntax, semantics and pragmatics. An important place in his concept is occupied by the question of equivalence, sufficiency and translatability in their interdependence.

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УДК 81'322

TATAR IDIOMS IN ONLINE TRANSLATIONS***Maksumov N.M.***

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The life of society has become much easier with the invention of online translators, due to them the use of standard bibliographic dictionaries has become completely irrelevant. One of the reasons is the time spent by a person: the online translator needs a couple of seconds to display the translation of a certain word/ sentence/ text on the screen. As for bibliographic dictionaries, even with its proper use and the ability of a person to find the meanings of words quickly, the translation requires a much greater amount of time. A person who does not understand the structure of the dictionary and the order of words can "wander" in it for minutes, an online translator, in turn, does not require certain knowledge from a person.

However, like any other achievement of the modern world, the online translator has a number of disadvantages. One of which is the use of vocabulary for all spheres of life in the modern world, which creates difficulties in the translation of many genres of literature, including technical literature. We are trying to examine the online translation of Tatar expressions into English.

As an example, we took the Google Translator, which is currently the most popular.

Phraseological units, idioms, phrasal verbs and stable expressions are the weak link of online translators. The translator outputs a literal meaning, that is, translates each word separately and displays this set of words on the screen with a sentence. We examined the phraseological units in the Tatar language: "Кирыкле кишер яфрагы", "Ятып калганчы атып кал". The translation issued by Google Translator has the following forms: "A banana leaf is needed" and "Go to bed before going to bed."

Yandex Translator translated these phraseological units as follows: "Carrot leaf with a pickaxe" and "Lie down, lie down." While the true translation has a slightly different meaning: "This is someone who was not expected" and "It's better to do than not to do and regret".

The idiom: "Баш вату" means to worry or think about anything, Google translator presents the translation of the expression "Broken head".

The idiom "Трай тибү" means "lazy", but Google gives "Try this".

While translating Tatar phraseological units it is important to understand the meaning of the text, the idea.

As for the numerous online translators such as "Translate.ru", "Google Translator", "PROMT", etc., then their proposed translation does not coincide with the main criteria of high-quality translation.

The languages of ethnic minorities in Russia are difficult to translate due to the fact that few people master them perfectly.

It became clear from the examples given, the language is characterized by the wide use of terms, word chains, modal verbs, etc. To translate the text correctly, methods of translating the language structures, words or phrases that pose the greatest difficulty into Russian were proposed. The description of these methods, in our opinion, is a part of the student translation training program. Without rejecting the possibility of using electronic translation, students can be shown in theory and in practice existing translation strategies and taught how to apply them.

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PROFESSIONAL ETHICS OF A TECHNICAL TRANSLATOR*Naumov A.D*

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Technical translation is a translation that is necessary for people who speak different languages, carried out for the exchange of scientific and technical information. In such a translation, every word is important, therefore, not just translators are engaged in such translation, but professional translators who are fluent in the language, who can competently translate using special terms. This means that the translator must be well-versed in a particular field, and have a linguistic education along with a technical one.

Ethical motives of the translator is surely important.

Communication between languages and cultures involves important issues for citizens and society as a whole, and various participants in translated meetings such as translator/translator, "client" and "user" face broad issues of social responsibility. These questions often arise unexpectedly and without the opportunity to think about response strategies. It is ethics in the translation industry that can prevent such problems in communication.

Translators and interpreters are hired for their ability to understand correctly what one client is saying and accurately convey it to another. The translator must translate accurately. By accurate translation, we mean a translation that preserves the meaning, style, and case of the original document.

Customers need to be sure that they can trust you not to share it with other people. The translator must, under all circumstances, respect the confidentiality and confidentiality of the information contained in all documentation.

The translator must show respect to all parties involved in the translation assignment, including respect for himself, the agency and its clients.

The translator must respect copyright and intellectual property.

The translator is responsible for his work and must recognize and acknowledge translation mistakes and try to correct them.

A technical translator should accept translations only for areas or subjects where he/she has knowledge and experience.

Also, the elements of the translator's ethics are his impeccable politeness and correctness, intelligence, comprehensive education.

The translator or the interpreter must not change the composition and meaning of the text when translating, shorten it or expand it at will.

The translator should refrain from comments and should not express his opinion.

In conclusion, we note that the ethics of the translator consists of moral rules, moral principles, a set of norms of behavior in society. Also, the translator must be modest, tactful, be able to keep a secret, be well-organized, and exclude an improper attitude to work.

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DIFFICULTIES OF LITERARY TRANSLATION

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Literary translation is quite a challenging job that entirely depends upon skills and qualities of a translator. The job requires not only to deliver authors message accurately, but also to express it in a culturally suitable way. The amount of time and patience it takes to translate a literary creation couldn't be overestimated. Furthermore, it enables people from all over the world to explore the beauty of literature and to enjoy the creative, fertile and highly imaginative minds of foreign authors.

When it comes to literary translation, one of the most common and crucial problems is the fact that source and target languages belong to *different cultures*. This leads to necessity to keep a balance to remain faithful to the original source with the requirement to create a work that is distinctive and unique, which will elicit the same feelings and reactions as the original work.

In translating literature, the style of the author and the story's atmosphere should be preserved. You may have missed the point that you are enjoying a book originally written in another language due to the skills and creativity of the translator.

Translators of literary works do not care for literal translation. The job requires the translation of idioms and local sayings. This leads to another issue that cultural differences entail, which is dealing with *missing terms*. The words or terms belonging to a certain nation or area may have no equivalent in another language, as those objects may not be used by the people, or those actions or activities may not be performed. In the cases like this one of the major points is to naturally apply the definition to these words, which mostly depends on imagination and eloquence of a translator. It also requires a large personal vocabulary, an ability to deal with humor and play on words that must be transposed into the target language.

Cultural difference is not the only challenge a translator faces. The structure of sentences in English and other languages may also be different. This is considered to be one of the main *structural problems* in translation. Language is complex, vast, and ever-evolving. Translators have to know the exact structure in the language, and use the appropriate equivalent, and they have to ensure that the translation is performed without changing the meaning as well.

It goes without saying that the importance of literary translation is immeasurable. The level of conscientiousness and devotion this job requires makes people respect and admire translators who have dedicated themselves to this difficult job.

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FEATURES OF TRANSLATION ENGLISH ORIGIN WORDS INTO RUSSIAN LANGUAGE IN THE FIELD OF COMPUTER TECHNOLOGIES*Titov S.E.*

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In this article we deal with the question how English origin words have become part of the vocabulary and what is their role at the present stage of society's development.

English origin words are written and pronounced in Russian the same way as in English. This phenomenon in the Russian language goes back to the XVIII-XIX centuries. At different stages of the development of society, the number and the subject of borrowed words differed. For example, at the end of the XVIII century, terms from handicraft industries and shipbuilding were borrowed, in the XX century English origins were actively used in the field of sports, and nowadays English has become part of youth slang and is used for product names and companies. Why are English words increasingly appearing in the Russian language?

One of the main reasons for their spread is the emergence of new terms. In the modern world, humanity is developing rapidly so new words are constantly appearing, which most people learn immediately thanks to the Internet and begin to use them in everyday life, getting used to their pronunciation. For the same reason, some words have no analogues. These words include: laptop, virtual reality, messenger and others.

Some English words are borrowed due to the fact that they are easier to pronounce or describe the situation more accurately. For example, in Russian, an investor can be called a depositor, but an investor buys investments, and a depositor invests money. The word "fitness room" can be replaced with "gym", but the first option is easier to pronounce.

The influence of English origin words on different spheres of life is great. This affection is most noticeable in the field of computer technology, since it was in the USA that the development of IT technologies began and the main programming languages were created in English. For example, C++, Python, JavaScript and others. English has had a positive impact on the development of the IT industry, as it is international and relatively easy to learn, which reduces the threshold for entering this field and allows people of different nationalities to work in a team.

There are also many English words used in marketing. According to statistics, about 40% of Russian establishments have an English-language name. This is because English is considered to be beautiful and popular. This can be understood by translating several English-language brand names into Russian: "Burger King" on Russian language is "[KorolBurgerov]", "FunDay" is "[FanDey]", "Mybox" is "[MayBoks]". As we can see, the names in English sound more beautiful and unusual.

In addition to professional activities English is a part of pop culture and youth slang. This phenomenon is especially noticeable among subcultures: gamers, hypebeasts, rappers and others.

Thus, the role of English words in modern Russian is very large both in the professional sphere and in everyday life. Russian vocabulary helps in the study and understanding of a foreign language and transforms speech, however, excessive use of foreign words will lead to a decrease in the vocabulary of the native language, and in the end, it may lead to the extinction of the Russian language. We think the role of English is great, but it is necessary not to mix the vocabulary of Russian and English.

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MILITARY BORROWINGS OF THE 19TH CENTURY

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The topic of borrowings is quite interesting and relevant, because by analysing words, their etymology and origin, we can draw a complete picture of the formation of a particular language. Borrowed words are those taken from another language and changed according to the patterns of the receiving language. In many cases, a borrowed word, especially one borrowed long ago, is virtually indistinguishable from the native word without a thorough etymological analysis (street, school, face). The number of borrowings in the vocabulary of the language and the role they play is determined by the historical development of the people who speak the language. The most effective way of borrowing is direct borrowing from another language as a result of contact with the people of another country or with its literature. But a word can also be borrowed indirectly, not from the source language, but through another language. Military borrowings are, respectively, words borrowed from other languages and constituting the military vocabulary of the English language. They might be borrowed during the various wars and armed conflicts that characterized England.

The purpose of our project is to highlight the English military borrowings of the 19th century and to trace the ways of their appearance.

As it was stated above the bulk of the English language constitute the borrowings, almost 75 %. The military vocabulary is not an exception. Around 50 languages influenced English this or that way [2].

In the last century, after William the Conqueror invaded England in 1066, French words became the part of the English language. This was the time of the new French-speaking nobility, which brought with it a considerable number of military words of French origin. Later, the Hundred Years' War (a series of military conflicts between England and France in 1337-1453) caused further borrowings from French into English. All this led to an indelible imprint of French influence on the English language. The word 'army' itself was borrowed from Old French 'armee'. As well as the ranks, like "corporal" (from Middle French "caporal"), "sergeant" (from Old French "sergeant"), "lieutenant" (from Middle French "lieutenant"), "captain" (from Middle French "capitaine"), "major" (from Middle French "major") etc. [2]

Modern French contributes military English not so much but still provides it with some interesting cases, like:

word	from French	meaning
toparchy	toparque	command in a district, superintendence
abris	abris	places of shelter
intendant	Intendant d'armee	Principal inspector of all sorts of stores
helicopter	hélicoptère	device for enabling airplanes to rise perpendicularly [1]

French borrowings are sometimes difficult to distinguish from Latin, to be precise, it is difficult to distinguish direct Latin borrowings from indirect ones. For example, the word 'figure' could come both directly from the Latin 'figura' and from the French 'figure'.

Due to the fact that a huge number of lexical units were borrowed from French into English, many of which had a complex word-formation structure, the influence of French had a great impact on the English word-formation system. Certain French suffixes and prefixes found in borrowed words could be extracted from these words and used to form words from native roots.

For example: the suffix -able, derived from such loanwords as acceptable with accept; the suffix -ence, from excellence, evidence, violence [3].

The influence of German borrowings on the military vocabulary is closely connected with WW1 and WW2. These are the words and concepts which appeared during Hitler's regime.

The most famous of these are: Black Shirt (Schwarzhemd) - black shirts, der Fuhrer - Fuhrer, Gestapo - Gestapo, Nazi - Nazi, Stormtroopers (Sturmabteilung) - assault the Third Reich, blitzkrieg, bunker-bunker, Luftwaffe - air force, Wehrmacht - Wehrmacht [4].

As for the Spanish borrowings, they are few in number: 'guerilla' – denoting an irregular war carried on by small bodies of men acting independently; armada – Naval fleet; galleon – armed merchant ship, etc.

In conclusion we would like to say that borrowings are the main source of enriching vocabulary of every language. Military English was mainly influenced by French and German. In the 19th century the military borrowings are very few. That is mainly due to rather peaceful time. Nowadays it still continues receiving loans from different languages, but today the main influence on military English is made by the USA.

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ACTUAL PROBLEMS OF FICTION TRANSLATION

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Nowadays largely due to globalization the large number authors works in various languages and on various topics are becoming available to the world. Therefore, the problem of fiction translation is very relevant at the moment. This problem has always occupied a special place in the problems of translation studies, since it includes many controversial features that need to be paid

attention to.

In the work course, various scientific articles and publications were analyzed, on the basis of which it was possible to compile a certain classification of the main difficulties of translating fiction texts, as well as to give methods and ways of solving problems that arise during translation.

One of the main problems that can be encountered translating fiction texts is the choice: to convey the content verbatim or to make the meaning the main aspect, moving away from the accuracy of the original and using other methods to preserve the artistic features of the text. The meaning in translation is the most important text component, since the main task of the translator is to convey correctly the author's thoughts to readers, therefore, literal translation in fiction works, to put it mildly, is not appropriate. Another problem is the adaptation of wordplay, which is not always possible to convey accurately into Russian due to the peculiarities of the original language and culture. As an example, we can consider an excerpt from the novel "Good Omens" by Terry Pratchett and Neil Gaiman. The wordplay in this example is based on ambiguity. "He suspected that Crowley was from the Mafia, or the underworld, although he would have been surprised how right he nearly was." [4, p. 235] the word "underworld" has two meanings and can be translated into Russian like "преисподняя" and "преступный мир". The character of the book believes that the man in black is a native of the mafia or the underworld. However, he is actually a demon from the underworld. There are many such examples, and the translator needs to pay special attention to stable expressions. The language is very changeable, new words and phrases appear, which are reflected in modern art works. The translator needs to study all the nuances, including slang, in order to most accurately convey the semantic, emotional and artistic content of the text. Much of the translation depends on the translator himself, his abilities and his own adaptation and the text perception. In final qualifying work, A.G. Yelkina examines this problem by comparing the translation of the Harry Potter series of books authored by J.K. Rowling by two translators - M. Spivak and I. Oransky. The author of the work leads to the conclusion that the translators had a different interpretation of the novel main character, which led to the different portrait characteristics creation of the same hero.

It is quite a difficult task to compile uniform recommendations to translators, since in a work of fiction each speech unit has a special character and, accordingly, a special approach to translation.

A possible way to solve these problems, in my opinion, may be a more in-depth study by the translator of the culture peculiarities, the suitable dictionaries use regarding the aspect of the work writing date, historical events, the life of the author, etc., based on current dictionaries of synonyms and stable phrases and turns of speech.

As the analysis result and research of the problem, the following conclusions can be drawn: the primary task of the translator is to convey the meaning that the author himself has invested in the work. When translating, it is important to understand how the author feels his work and sees his characters, and try to convey this most accurately. The translator needs to pay special attention to stable expressions, speech turns, wordplay, phraseological units, trying to find the equivalent as accurately as possible and preserve the meaning embedded by the writer.

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WAYS TO IMPROVE ONLINE TRANSLATIONS

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Nowadays, more and more people need to translate information from one language to another, therefore, many online translations have been created for a comfortable translation. Online translations are a great help in quick work, but not everything is as perfect as it seems.

People note the high speed translating and do not notice that online translations do not work exactly as they should. They lose the precise thought of the information conveyed and provide a different result from what is expected. Due to the incorrectness of the information provided, the entire result of the work can become completely different, and all the material may turn into a useless set of words that are not related in meaning. For this reason, you cannot trust completely the online translator, and people have problems with completing the task. After a person sees an improper translation result, he will no longer have a desire to use this online translator, and in the future he may refuse online transfers altogether, because he considers their functionality to be a waste of time.

There are some ways to improve online translation experience that can improve considerably translation productivity.

1. Understanding the principle of software (software) operation. The simplest programs translate words separately, observing only their sequence, regardless of the relationship between words. The choice of translation should be made in favor of the software that conveys accurately the connection of parts of sentences, and also has such a function as a translation storage device for the best selection of translation.

2. Preliminary preparation of the text. It is necessary to understand that software is not capable of perceiving complex structures consisting of a large number of punctuation. The sentences should be simplified as much as possible for a more accurate translation. A translator also needs to check the document for any mistakes. If the rules of punctuation, grammar or vocabulary are not followed in the document, the program will not be able to translate the text.

3. Working with several programs at once. Using 2-3 translation programs at once, the result will be much better. In this way, one can check and select a proper translation.

4. Correction of the document. No matter how perfect the software is, it is not able to translate the text exactly. Therefore, after the translation, it is necessary to check the correctness of the result.

5. Verification. After the translation performed with the help of software, you should contact a specialist to check the exact transfer of information.

6. Completion of the translation dictionary. After the revision of the translation, one should add new words or phrases to the dictionary for further successful work.

Thus, summing up the study of ways to improve the work of online translations, it can be noted that online translations are not yet ideal, and there are many aspects aimed at improving the functionality of online translations.

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**EFFECTIVELY ENGAGING TEXT AS A BASIC UNIT OF COMMUNICATION IN EFL
IN LEARNER CENTERED CLASSROOM****Khamidova N. N., Raskhodova I.A.***(Kokand State Pedagogical Institute,**Kazan National Research Technical University named after A.N.Tupolev)*

In the modern world, the importance of education is increasing as the most important factor in the formation of a new quality. A foreign language today is not just a part of the culture of a certain nation, but it is also the key to success, the young learners' future successful career. Achieving a high level of proficiency in a foreign language is impossible without fundamental language training in education system. It is important for the teacher to know the latest methods of teaching a foreign language, special teaching techniques and techniques in order to optimally choose one or another teaching method in accordance with the level of knowledge, needs and interests of learners.

Engaging texts for EFL teaching can be considered as a form of speech actualization of linguistic units, as a structural-semantic integrity; allow recreating the integration of meaning in the production and perception of the text, and as a basis for the formation of related skills in receptive reading and reproductive types of speech activity. Learners "pass through the text" they learn to pass through themselves, texts, since communication skills when working with engaged text are formed under the condition of reflection, because the carrier of any installation is a centered-learner (creating it and perceiving it).

The basic principle of learner-centered learning by using effectively engaging text: the pupils should be in the center of learning, the activity of knowledge, not teaching. In class, most of the time should be practiced by pupils, not a teacher. At present, pedagogy is intensively searching for a rational organization of the educational process that would stimulate the development of the interests of pupils by working on different engaged text activities which includes integrated skills and help pupils to immerse in it totally.

According to I.R.Galperin, *"The engaged text in learner centered classroom - is a work that has a specific focus and pragmatic installation"*. The definition of a text can connect with the completion of the minimal act of communication, the transfer of information or the exchange of thoughts between partners, this is a concept, then a mental formation, which in linguistic literature is called the integrity of the text [1, p.18].

The text as a stimulator of motivation is defined as a *"means of verbal communication"*, as a communicative unit that implements the author's intention, speech work communicatively oriented within a certain sphere of communication. Recognition of the text as a motivation for language learning the main communicative unit and, as a result, appeal to it in order to comprehend the language in communication expands the horizon of linguistic research itself to the limits of verbal and cogitative² activity. The text in learner centered lessons is represented as a *"direct manifestation of thought"* which can be used effectively to motivate learners to improve communication skills and its functional essence is determined by its role as an instrument of social interaction between people [2, p.44]. Reflection of communication in learner-centered classes can be manifested in the creation of their texts (essays), the recycling of texts (presentation), the interpretation of texts. Communication is a complex process of interaction between learners, consisting in the exchange of information as well as in the perception and understanding of each other by partners. Exploring the engaged text as a stimulator of motivation, learners acquire communication skills ability to listen, to express their point of view, come to a compromise decision, argue and defend their position.

Being thus an objectified form of the act of communication, the text assumes the existence of

not only the subject of communication and its author, but also the recipient. It is in the effectively engaged text that there is one time:

- And the author of the message (his socio-cultural environment, his experience, attitude to the world, etc.);
- And the message itself;
- And the addressee (the recipient of the message in his personality-activity manifestation, such as interpretation).

In teaching foreign languages of learner-oriented lessons by using motivational texts, searching for text with the appropriate language level it is very important. Learner-centered content is the main source in various concepts and methods in teaching and learning English as a foreign language. For instance, choosing appropriate materials for teaching is significant strategy, which can be used to produce learners' motivation as the main part of teaching motivational practice [3, p.97].

Designing learner-centered content can take on special form:

➤ the installation of prevailing speech activities so that it contains the topic selected by the learners to advance a six-week project around object, especially important for a group of learners. This section covers methods, ideas and samples for the design of the centered-learner content. Majority of these principles are taken from literature encircling projects and project-aimed learning but this is correspondingly true when classroom activities design: According to Harmer, The difference among a complete project and speaking or writing activities mostly exist large-scale [4, p.206].

➤ Choosing engaging texts and designing content-based on a topic, that learners are interested in. This interest may be based on learners' interest or teachers' initiation actively trying to peak students' curiosity. The most common means of it is to find out about the learners' interests to ask them: homework can be shown in the examples of the three items that they find interesting during the learning process (from newspaper articles to a new couple coaches on the avenue from the institution they taking into account participation), or for the dividing of learners into groups during the lesson, you can offer three interesting topics.

➤ Choosing engaging texts and designing content teachers should emphasize such important factors about which learners mightn't be informed: for instance approaching events, a possible project or technological innovation or challenge that language learners could communicate with. Even though it is predictable that not all submissions will "hook" centered-learners, these offers can inform the teacher to get information about his learners. If they were entered at the end of the week or class, students can elect on what they desired to learn more about the next class meeting, consequently additional raising the level of interest and expectancy.

Selevko suggests that the learner-centered content in education is designed to help a learner to build his own personality, determine his own personal position in life: choose meaningful values for himself, master a certain knowledge system, reveal the range of scientific and life problems of interest, master the ways to solve them, discover the reflective world of his own and learn to manage it.

The criteria for effective organization of learner-centered content are the parameters of personal development. Thus, summarizing the above, it is possible to give such a definition of student-centered learning.

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SPEECH EXERCISES AS A NECESSARY COMPONENT OF THE FORMATION OF THE COMMUNICATIVE PERSONALITY OF STUDENTS IN TEACHING FOREIGN LANGUAGES***Khamidova N. N., Raskhodova I. A.****(Kokand State Pedagogical Institute,**Kazan National Research Technical University named after A.N.Tupolev)*

Nowadays, more and more gaining popularity is not just learning English with its grammar and versatile vocabulary, as well as free speech, which will not only show your broad knowledge of the language, but also develop a communicative personality.

For this, the philologist must have deep and extensive knowledge both in the methodology of teaching the English language and in the theory of modern English literary language. So, one of the important components of teaching a foreign language is the formation of the communicative personality of the student. To solve this problem, English lessons play one of the main roles of speech exercises, which in turn are an important component of the lesson.

Speech skill is a complex phenomenon, the formation of which is very important to consider all its features. With the effective formation of this skill, students need to purposefully perform each speech exercise. Each speech exercise carries a specific goal. So, imagining the goal of the exercise, the students are aware of the role and place of this action in the overall leading activity, i.e., the awareness of the language rule by which the speech exercise is performed and the plan of their own action program is formed. When forming a speaking skill, it is also necessary to take into account the correct distribution of exercises over time. For example, in the opinion of I. A. Zimnyaya, the greatest number of exercises should be given at the beginning of the training, then, as the training time increases, the interval between exercises should increase. Such training must be maintained from the beginning to the end of training. [1]

Speech exercises have certain typological features:

- ensure the presence of the speaker's strategy and tactics;
- actualize the relationship of the participants in communication;
- always a new situation, which ensures the productivity of the statement;
- develop speech activity and independence, etc.

Passov E. I. divides speech exercises into two groups: exercises for the formation of skills and exercises for the development of speech skills. [2] But using only a complex of these groups of exercises, it is possible to form all aspects of speech skill. Examples of such exercises can be:

- an oral statement on a given topic within 30 seconds - 1 minute. If the teacher noticed that the student is experiencing some difficulty in expressing his thoughts, then you need to use a pre-prepared list of leading questions or subtopics that stimulate the activation of the student's thinking. This exercise is aimed at developing fluency in speech and forms the flexibility of thinking; - exercise to build relationships. This type of exercise forms a continuous thought process and a logical transition to given topics, phenomena or objects;

- association exercise. Here the ability of students to substantiate their associations is formed, associated with a given word;

- exercise to build synonymous rows. English is one of the richest languages in the world. And studying a literary text, one can find a rich abundance of synonyms. This exercise stimulates easy and quick learning of new words.

Thus, speech exercises form the ability to formulate your thoughts and express them in English, motivate students to encourage free speech.

Exercises and activities used in teaching speaking skills.

I TYPE

Reproductive exercises form materially operational basis of speaking (lexical, grammatical, background-imitation exercises substitution, transformation, combination).

II TYPE

Productive Exercises provide students with the opportunity to use the generated skills in solving communicative tasks.

Stage I - preparatory. Purpose: the formation of mother the operational side of speaking. At this stage, development of language automatisms, skills of fast and the unmistakable use of phonetic, lexical, grammatical material. The focus should be on pour the form of utterance, but the content nonetheless also important. Reproductive exercises (imitation, substitution), reproductive and productive (substitution, transformation, combination).

Stage II - training in prepared speech. Goal: forms the content side of speaking. Stage -prepared expression teaches the selection of language tools appropriate to the goal communications. Attention is flexibly distributed between the form and content. The focus is on the expression of content using adequate logical and structural material.

Two levels can be distinguished here: micromonologist level and microdialogue, i.e., the basic units are formed and etc. The level of detailed dialogue and monologue.

Stage III - training in unprepared speech. Formation and development of skills of initiative speech, free speaking. In the methodology, exercises are usually divided into types, among which types of exercises are highlighted. Consider the types and types of exercises opinions aimed at teaching monologue speech. [3]

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ONLINE TRANSLATORS. PRESENT AND FUTURE

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Human interaction with a computer is one of the urgent tasks of technology development. Its solution will result in quality of our interaction with the devices and applications, distribute effectively attention when dealing with them, and automate routine operations when processing information.

The aim of this paper is to explore the possibilities and prospects of online translators.

Traditional phrasebooks and dictionaries are becoming outdated, and online translators help to find the right word or phrase much faster. The speed of the translation is greater than the ability of the translator, but as for the quality of the translation, we will examine it in our work and draw our own conclusions.

The machine translation has advantages in terms of speed and cost - it is instant, and usually free. While machine translation will revolutionize the translation industry, it will by no means make human translators obsolete soon.

Machine translation is not suitable for all types of text, especially for those involving more complex, literary or idiomatic language. The results produced by the online translators are often not suitable for publication and still need to be checked by a human editor.

The translation cannot use the mathematical principle, because the direct translation of words

does not guarantee the accuracy. In fact, the inability of engines such as Google Translate to translate the content exactly is often the subject of jokes on Twitter and Instagram.

The translation is likely to be a form of writing, the later turns out to be an art form. This is the difference between professional human translators and machines. Computers do not understand context or culture and cannot vary and play with the words and syntax.

The paragraph construction requires not only the knowledge of language, but also the cultural sensitivity and the mastering of the specific contexts, idiomatic expressions, tone and style, and in the case of companies the corporate language and identity is required to understand the words put together into sentences.

The use of a machine translation can be useful for fast, non-vital, low-priority content, but corporate communication that corresponds to a specific company identity should be translated by human translators [2].

As for post-editing, we would say that the benefits are not really significant unless you put speed over linguistic quality.

For example, this year Microsoft announced the creation of the artificial intelligence that can translate as well as a human. The robot translated a series of Chinese press articles into English, and a group of independent experts concluded that the quality of the translation was comparable to two professional translators translating the same texts.

The company noted it was achieved due to the deep neural networks and statistical machine learning [1]. Firstly, a rough translation takes place, which is then polished by repeating different variants, comparing them and, ultimately, learning. People learn to translate in a similar way.

The translation tool developed by the company has a clear idea of the grammatical structure in each language, which has developed from previously performed translations.

Machine translation, the quality of which is comparable to the quality of human translation, seems to be quite an impressive achievement. But even Microsoft recognizes that the translation of news articles is not the same as the translation of a live conversation, which is characterized by idioms, accents and dialectical features.

Some of the most promising translation jobs are available in Chinese, German, Russian, Portuguese and Spanish, which are among the most important languages for business in the global market. Although one might think that translation applications threaten the work of translators, in fact they create new opportunities [2].

Despite recent advances in artificial intelligence, machine translation software still needs the supervision of professional human translators. This can ensure that the correct dialect, grammar and translations were used when interpreting voice notes and texts.

Although algorithms are becoming more and more accurate, machines still cannot beat human translations when they come face to face with each other. Last year, Sejong Cyber University in Korea compete three machine translation programs with a group of human translators, and the machines did not meet expectations. Although the machines were much faster, they made more mistakes in the final documents, and 90% of the machine-translated texts were "grammatically incorrect".

To solve this problem, more specialized knowledge is required when creating a machine translator. Hiring technical translation experts can help make the technology more accurate, providing a better product. Then enterprises can use this technology to promote their products to overseas customers and reach a more global audience [3].

Summing up, we can say that online translators are still not able to form coherent, grammatically correct sentences when translating a fragment of text or information, which makes them much less reliable than a human translator. For industry translations, such as law or medicine, businesses will need to provide highly accurate translations that human translators will be able to perform much better.

For these types of translations, translators will be trained in terminology to ensure accurate translation. While experts are working on fine-tuning machine translation algorithms to make them more accurate, human translators will be more reliable for companies seeking global growth.

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TRANSLATING FEATURES OF ENGLISH PHRASEOLOGICAL UNITS INTO RUSSIAN

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Phraseology is a stable phrase peculiar to a certain language, the meaning of which is not determined by the meaning of the individual words that make up it.

In literature works phraseological units are one of the most important stylistic means providing the expressiveness and the beauty of forms. While preserving the imagery of phraseology the text does not lose expression which makes it non-standard and interesting. Most people do not know how to translate these stable expressions literally. As a result the problem arises: a literal translation leads to the misunderstanding of the text.

There is *a hypothesis* that the literal translation of phraseological units loses the meaning and expressiveness of the sentence. For example, the following phrases have problems with translation:

"A round peg in a square hole" - круглый колышек в квадратном отверстии;

"To turn back the clock" - повернуть часы назад;

"Put the cart before the horse" - поставить телегу впереди лошади;

"Dine with Duke Humphrey" - обедать с герцогом Хамфри;

Of course, mistakes can be avoided by studying various translation methods. To do this, most researchers identify four main ways of translating phraseological units:

- 1) The method of phraseological equivalent
- 2) The method of phraseological analogue
- 3) Literal translation or calculus
- 4) Descriptive translation

The first method allows a person to save a set of values of the original phrase. This method is used only if it is possible to find a phraseology that corresponds correctly to the original. This method involves reproducing the foreign phraseology in a proper way. Thus, the stable expression "A round peg in a square hole" can be translated using the Russian phraseology "быть не на своём месте".

The second method is a search for a phraseology with the same figurative meaning, but using different images. So, the phraseology "To turn back the clock" can be translated as "повернуть вспять колесо истории", replacing the word with the literal translation of "часы" by "колесо истории". The meaning will not change, but a suitable image is used.

The third method can be applied only if the resulting expression is easily perceived by the reader, and a feeling of the violation of the norms of language is not seen. Consequently, the phraseological unit "Put the cart before the horse" and its literal translation "поставить телегу впереди лошади" is perceived clearly by the reader, thereby the structure and norms of the language are not violated.

The fourth method is used when it is impossible to apply any of the above methods of

translation, then the translator should resort to descriptive translation. The English phraseology "Dine with Duke Humphrey" arose due to the fact that beggars asked for food near one of the London churches where a certain Duke Humphrey was buried. There is no similar expression in Russian, so the translator must write "ходить голодным; остаться без обеда".

To sum up, we can say that the *hypothesis* is partially confirmed when we try to translate phraseological units literally, but often the sentence loses its meaning and expressiveness. It is worth avoiding the calculus method; however, this method is allowed if it is impossible to use other methods. Translation mistakes occur due to the translator's lack of competence, so it is necessary to study in detail all the methods that contribute to the correct translation of phraseological units.

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СЕКЦИЯ 4

ПРОБЛЕМЫ ПЕРЕВОДА СПЕЦИАЛЬНОЙ НАУЧНОЙ ЛИТЕРАТУРЫ

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УДК 378

LACK OF TRANSLATION SKILLS AS A DEFECT IN THE AVIATION SPECIALISTS TRAINING DEVELOPMENT OF TRANSLATION AND INTERPRETATION SKILLS AS A WAY TO INCREASE THE LEVEL OF AVIATION SPECIALISTS LANGUAGE PROFICIENCY

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Abstract: The article deals with problems of the language training of aviation specialists. Analysis of the language training programs of Russian aviation institute and university revealed deficiencies in Aviation English training. Recommendations for improving language training have been developed and are presented by the author.

Key words: aviation, education, ICAO, language, skills, training.

The priority in communications skills development was determined in Circular 323-AN/185 «Guidance for Aviation English Training Programmes» which was published by the International Civil Aviation Organization (ICAO). The document was developed with consideration of the experience of the members of the International Civil Aviation English Association (ICAEA) which is focused on optimizing standards in Aviation English training. Although grammar, syntax, vocabulary and reading underlie oral communications, the primary objective of aviation English (particularly radiotelephony phraseology) training is voice-only communication. Therefore, Aviation English training must essentially adopt a communicative approach to language learning with the main focus on speaking, listening and interaction skills. Nevertheless, job-related activity of aviation specialists implies documents management (manuals, instructions, regulations, reports). That is why aviation specialists have to be able to adequately translate industrial documents since most of them are released in English.

In fact, presented Circular 323 was published back in 2009 so it could be assumed that approach must have become irrelevant. The purpose of this work is to examine and evaluate modern language training programs in aviation using comparative analysis and to give recommendations if possible.

The 39th session of ICAO assembly considered the deficiencies in the ICAO language proficiency training policy. Respected linguists, experts in test developing identified noticeable deficiencies in the language training policy proclaimed by ICAO in the previous decade [1].

As a rule, language training syllabus includes a number of courses such as: English (general), English (Aviation English), Professional Aviation English, Radiotelephony Phraseology in English, Technical Aviation English (elective), Aviation English in air navigation, Spoken English (or what should be taught as General Aviation English).

Programs were worked out to develop language proficiency in aviation domain in two main Russian high education centers: Saint Petersburg State Civil Aviation University (SPSCAU) and Ulyanovsk Civil Aviation Institute (UCAI). These programs were studied, compared and analyzed.

The system of special courses to develop language proficiency in aviation domain are shown in tables 1 and 2.

Table 1 - English language training programs in SPSCAU

Course areas	Academic terms		
	Air Traffic Controllers (Specialist's degree)	Pilots (Bachelor's degree)	Pilots (Specialist's degree)
English (Aviation English)	1,2,3	1,2	1,2,3
Professional Aviation English	4,5,6	3,4,5	4,5,6
Radiotelephony Phraseology in English	7,8	6	8
Technical Aviation English (elective)	-	6,7	7,9
Aviation English in air navigation	9,10	-	-

Table 2 - English language training programs in UCAI

Course areas	Academic terms		
	Air Traffic Controllers (ATC) (Specialist's degree)	Pilots (Bachelor's degree)	Pilots (Specialist's degree)
English	1,2,3	1,2,3,4	1,2,3
Aviation English	6,7,8,9	5,6,7,8	6,7,8,9
Spoken English	4	5	4
Radiotelephony Phraseology in English	8,9	8	9

The following characteristic features of the language training syllabus in the aviation institute and university were identified based on comparative analysis of language courses:

1. At the initial stage of the language proficiency development at UCAI, language training is based on familiarization with primary lexical and grammatical tools, development of speaking and listening skills during monologues and dialogues. The scope of communication includes formal and informal speech in the routine interaction field, basically, avoiding professionally orientated issues.

2. The process of language proficiency mastering in the aviation sector is carried out gradually from general English to the language of professional activity. The presented training sequence should guarantee confident language proficiency in General Aviation English.

3. There is no compulsory course targeted at development of translation and interpretation skills.

4. Language training in SPSCAU at the initial stage covers professionally oriented field and is represented by English (Aviation English). The acquisition of the language competence necessary for carrying out professional activities begins already at the initial stage of education.

5. The language training syllabus of SPSCAU is focused on Aviation English, moreover training makes speaking and listening skills a priority.

6. The course, within framework of which development of translation and interpretation skills could be provided is elective.

In point of fact, language training of such specialists as pilots and air traffic controllers is focused on communication skills, which is essential but does not guarantee 100% successful professional activity on foreign-made aircraft. Professional training of pilots and air traffic controllers both in SPSCAU and in UCAI does not imply the development of a specific skill - adequate translation. Though there's a course which is called «Fundamentals of scientific and technical translation» in UCAI nevertheless it's studied only by specialists in aviation security and search and rescue of master's degree.

In 1992 the first types of foreign-made aircraft (Airbus-310) arrived at Sheremetevo airport in Moscow. Since the USSR breakup domestic aircraft were being gradually replaced and now have almost been supplanted by foreign makes. Consequently, thousands of Russian specialists are encountering the necessity to read manuals, instructions, industrial documents in English. By the end of 2021 most Russian airlines still operate foreign-made aircraft. Moreover, the fleet of some airlines is 100% composed by only foreign planes, for example, Boeing in «Pobeda» airlines or Airbus in «Ural airlines».

To be able to fly different types of aircraft and to get professionally promoted every pilot has to study a lot of educational materials including those published in English. The standard list of course books consists of «Airplane flight manual», «Flight crew operating manual», «Flight crew training manual», «Minimum equipment list», «Quick reference handbook», «Standard operating procedures», «Weight and balance manual». The future air traffic controllers work with specialized publications by ICAO, including PANS-ATM (Doc 4444) and the Manual of Radiotelephony (Doc 9432), Annexes to the Convention on International Civil Aviation and other documents.

Comprehensive understanding of specialized aviation texts, including ICAO documents, depends on the appropriateness of the translation. There is no doubt that it's possible to refer to already translated works but specialists are likely to meet some obstacles. Firstly, there's a high probability of long wait for the documents translation. Moreover, it's possible that necessary document will not be translated at all. For example, there are no Russian Edition (since 2012) of annual Safety Reports published by ICAO. Secondly, inaccuracies and mistakes can be found even in officially translated ICAO documentation. For example, in Chapter 1 of Russian edition of Circular 323-AN/185 there is a phrase «Are you ready for immediate departure? », where the word «departure» wasn't translated properly. Consequently, the translation was misleading in spite of the fact that the whole phrase was a standard collocation from the list of standard phraseology and had the only one translation option [2]. Such situations can be confusing and even result in safety vulnerability.

As a result of the analysis of the language training syllabus of aviation specialists at SPSCAU and UCAI, the absence of a compulsory specialized course targeted at development of translation and interpretation skills was revealed. Aviation specialists are making a significant contribution to the safe functioning of the industry, therefore training these specialists to effectively use English in professional sphere requires a more comprehensive educational approach [3].

In accordance with Federal Educational Standard, it's essential for future air traffic controllers to work with ICAO documents while studying. Future pilots have to study Technical Aviation English since technical awareness (of foreign-made aircraft) is an essential part of their professional competency. Unfortunately, students have to acquire necessary skills at additional courses of Technical Aviation English on a fee-paying basis.

The acquisition of translation and interpretation skills will not depend on financial situation of students but will be a part of general educational training syllabus with the introduction of compulsory specialized course. Translation and interpretation skills give a lot of advantages for aviation career. Furthermore, these skills will create perfect fertile ground for further self-development and self-education with the aim of constant self-improvement.

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DIFFICULTIES OF TRANSLATING TATAR PHRASEOLOGICAL UNITS INTO ENGLISH

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Phraseological units are stable expressions, one of their features is that it is almost impossible to translate them into other languages. And if a person does it verbatim, there will be an expression that does not coincide in meaning with the original source at all.

For example, Tatar phrases have the following translation:

Йөрәк серен ачып бирү -Revealing the secret of the heart

Акыл сату - Mind Trading. When translating this expression from English to Tatar, the online translator gives the phrase which can be translated as “Сәүдә акыл белән”.

Сүз боткасы - The word porridge. It is also translated as “ботка”.

Tatar native speakers will understand immediately what it is talked about.

Йөрәк серен ачып бирү -Revealing the secret of the heart

This phraseological unit means that someone tells sincerely, shares his cherished thoughts, experiences, feelings. The phraseology has a very deep meaning. The heart is the most important organ in human life. And thus, everything that happens in our heart is reflected in ourselves externally and internally, and what we keep in our heart is always the most intimate. Therefore, when someone shares their secrets, experiences, it is customary to use the phraseology "open the heart / soul"-“йөрәк серен ачып бирү”.

Phraseological units usually consist of two or more words.

Куян йөрәк (rabbit heart)

Since ancient times, hares have been associated with animals that are afraid of everything in the world. Therefore, in order to describe or show that someone is cowardly, timid, the phraseology "куян йөрәк" is used in Tatar language. There is also a synonym for this phraseology "чыпчык йөрәк" (heart of a sparrow), which translates as "sparrow heart". In the Tatar language, the use of a sparrow as a timid bird is not uncommon. Therefore, you can safely say "чыпчык йөрәк" and you will also be perfectly understood.

Йөрәккә якын алу (getting close to heart)

This phraseology has two meanings. The first meaning of the phraseology is "to worry a lot, to suffer, to be afraid, to hurt the soul", the second meaning is "to treat something with too much attention".

It is possible to replace phraseological units with one word for another. For example:

Кот очу – Nightmare;

Авыз еру – Vomiting;

Sometimes phraseological units in different languages express the same meaning, but do not coincide in composition. Such peculiar phraseological units are called idioms (original interpretation).

Кызыл кар яугач - The Red Crow

Табан ялтырату - Sole gloss

Исе дә китми - It doesn't smell

Thus, Tatar phraseological units, as well as phraseological units of other languages, are difficult to translate phrases, their literal translation is impossible, one can only choose an expression similar in semantic meaning in another language.

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TECHNICAL TRANSLATION. THE PROCESS AND THE RESULT

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Technological progress and modernization of our life requires looking for new sources of information beyond the borders of the country. Every day, a huge amount of information about modern technologies, research methods and scientific and technical achievements is published all over the world. Most of this information is available in languages unknown the majority of us. In order to understand what is printed it is necessary translate correctly the originals.

The text necessary for the exchange of scientific and technical information between people from different countries is called technical translation. Technical literature includes documents, notes, articles and reports, research papers, scientific articles, the list goes on.

What fields does technical translation cover?

Technical translation deals with the texts in following areas:

- Instructions for the use of various tools, complex technical devices, vehicles;
- Design of buildings, architectural projects;
- Documentation for tenders and international competitions;
- Agreements, contracts, agreements with foreign sponsors, cooperation partners for the supply of machinery or special equipment;
- Methodological manuals with instructions and recommendations on maintenance and repair of machines and mechanisms;
- Dissertations, theses and other scientific works;
- Patents, certificates, licenses, permits;
- Computer software and programming.

Professional translation is widely used by graduate students and teachers from universities and research organizations, as well as managers and employees of companies.

Unlike literary translation, technical translation should be as reliable as possible, which is the main difference and the main problem. The preservation of terminology, the forms of statements, a clear awareness of statements to be translated distinguishes a competent translator from an amateur or a beginner.

The main purpose of a technical translation is to combine knowledge of a foreign language and knowledge of a technical issue. The translator should master perfectly the language and should understand the subject matter and terminology of the translated text well. There has always been a debate what basic education a technical translator should have. Some people believe that basic linguistic education is required, others claim the translator should be trained in technical knowledge and skills. Specialists argue that professional technical translation requires knowledge in the technical field and that a good knowledge of a foreign language is not so necessary, especially when translating into one's native language.

Characteristics of high-quality technical translation.

Technical translation is characterized by the accurate expression of the main meaning, avoiding emotional coloring and free opinions, otherwise the meaning of the original will be distorted. It is better to avoid complex constructions and phrases that make it difficult to perceive the ideas expressed.

The abundance of terminology is noted. It is important to preserve all terminology and consistency so that the text remains reliable, literate and understandable for specialists. The same term may have several synonyms in another language, so the translator should know the terminology of the area he or she is translating.

Abbreviations are present. Technical texts contain many abbreviations with different meanings. This should be taken into account when working with the material, so as not to change the meaning of the issue printed.

Technical standards and norms should be strictly followed. When translating, it is important to observe rules and norms and translate accurately in an informative way.

Special phrases and phrases are also seen. The original text may contain unusual expressions that have no equivalent in other languages. The translator must find the correct word that does not contradict the meaning of the work, and find new expressions.

Several meanings of the same word could be a problem. A translator who is not familiar with the content of the translated text may think that this is a mistake or a typo. While translating one should avoid long sentences, ambiguous sentences and numerous descriptions in technical texts.

The process of translating of a technical text is a painstaking, responsible task that requires the translator to know not only a foreign language, but also the subject of the work being translated. It is important to go into the essence of the original source, check scrupulously the materials, see the mistakes and inaccuracies. Such work requires absolute concentration and integrated approach.

The difficulty of technical translation consists in the use of a large number of complex terms, abbreviations, and many other aspects. In this regard, technical texts should be translated not just by translators, but by specialists who are fluent in the language and understand a certain direction of the translated materials.

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PROBLEMS OF TRANSLATION OF SPECIAL SCIENTIFIC LITERATURE

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Abstract. In order to be aware of new discoveries and to know their reliability, it is necessary to receive a professional translation of information from a foreign language. A translator of special scientific literature should actively speak a foreign language and be able to work with a foreign text in order to extract information and formalize it in the form of translation. Indeed, in practice, translation often causes difficulties due to certain specifics of the English language.

We live in the 21st century, the age of information technology. The modern world is rapidly changing and dynamically developing, poses many new challenges to our country. Now our life depends heavily on scientific discoveries and modern technologies. Knowledge of a foreign language is a mandatory component of the professional training of a modern specialist of any profile.

Thanks to the means of communication that help scientists from all over the world to instantly exchange information and conduct joint research, modern science has managed to achieve unprecedented results. In such conditions, the need for high-quality translation of scientific

literature has significantly increased. There is a great need for specialists who are versed in various fields of scientific and technical translation and are able to competently and adequately carry out both written and oral translation of not only general scientific, but also narrow-profile technical terms.

According to A.I. Melnikova, scientific and technical translation is the translation of special texts of a scientific and technical nature, carried out by specific methods other than the translation of fiction [1]. As for the purposes of translating scientific and technical texts, the main ones are to achieve adequacy and equivalence. This means that the translation must convey the content of the text in a foreign language, while observing all the norms of the translating language.

According to A. L. Pumpyansky, "Scientific and technical literature is of exceptional interest not only in content, but also in form. In addition to a huge number of books on science and technology, more than four million articles are published in journals worldwide every year"[2]. At the same time, translators often face specific difficulties that are hidden in the linguistic features of scientific literature and do not know how to fully use all the methods of text conversion when translating.

Komissarov V. N. defines translation as a type of language mediation, which is entirely focused on the foreign-language original [3].

If we mean translation from one language to another, then here translation can be considered as a process and as a result. In the first case — it is an action that makes the translation text appear. Translation as a result, in turn, implies a ready-made translated text.

Translation (interlanguage) transformations are transformations by which the transition from the units of the original to the units of translation in the specified sense is carried out.

When carrying out transformations, the translator must take into account linguistic, cultural and psychological factors:

- 1) the language factor is expressed in the translator's choice of the appropriate type of transformation of the elements of the original text;
- 2) the cultural studies factor is expressed in taking into account the socio-cultural traditions associated with the use of text elements when translating;
- 3) the psychological factor is expressed in the translator's assessment of the measure of information ordering of text elements based on personal experience and assumptions about the experience of the author of the source text and the recipient of the translated text.

It is very important to pay attention to the difficulties that a specialist may face when translating scientific and technical literature. I. D. Lyutkin divides all the difficulties that a translator may have into two large groups: linguistic and organizational and legal, which are closely related to each other [4]. Linguistic difficulties cover a number of important problems related specifically to translation:

- Achievement of translation adequacy.
- The discrepancy in the linguistic means of the two languages when expressing the same concepts.
- The variety of topics of translated materials from different fields of knowledge, with which the translator should be well acquainted.

As for the organizational and legal difficulties, I. D. Lyutkin argues about the weak development of the categorization of full-time translators, its isolation from other difficulties and features of the work of translators [4].

Turning to the problems of translating scientific and technical terms, let's start with the fact that even the most experienced translators have them. Many of them believe that it will not be difficult for them to translate a particular term, simply by choosing a good dictionary for this. But, having met with such a problem as the absence of the desired term in the dictionary, they understand how much they were wrong. In this case, the main task of the translator is to find a qualitative analogue to a term that has no equivalent at all. Such a term is called equivalent-free. Finding the most suitable of all requires a good awareness of the field of knowledge with which the translator works, as well as a detailed analysis of the context. The construction of the equivalent of the term requires

a huge responsibility, since an incorrectly translated term, moreover, entered in the dictionary, can confuse even a technical translator with many years of experience.

Romanova O. N. and Dolinskaya A.V. in their textbook on the basics of technical translation touch upon the topic of lexical difficulties in translating scientific and technical one-component terms [5].

We all know that the English language is distinguished by the presence of words with an abundance of different meanings. This phenomenon is called polysemy. A separate difficulty belongs to the translation of homonyms (words of the same sound, but different in meaning). For example, maybe a tin can. Moreover, Romanova O. N. and Dolinskaya A.V. consider the problems of translation of internationalisms and cite the word "satellite" as an example. It has such meanings as "accidental companion", "life partner" (spouse, spouse) and "spacecraft orbiting the earth". In English, the word satellite is only "spacecraft". Together with the so-called "false friends of the translator", they can also cause some difficulties in translation. The greatest difficulties in translation arise with the last group of terms. They are called multicomponent. This is due to the fact that the words present in these terms can be taken from different areas and be completely different parts of speech.

Having considered some general features of the translation of scientific and technical texts, it is worth saying that the most important and important feature of scientific and technical texts, which can also cause a number of difficulties in translation, is the presence of specific terminology that requires the translator to know the terms of a specific field.

The terms should provide a clear and accurate indication of real objects and phenomena, establish an unambiguous understanding of the transmitted information by specialists. The difference in the terminological systems of different languages is the cause of the greatest difficulties in translating scientific and technical texts. This implies the need to compare terminological systems and search for ways to translate partially equivalent and non-equivalent vocabulary.

Thus, when translating terms that have no equivalents, the translator has to use the following techniques:

- calculus using grammatical and lexical transformations (replacement of parts of speech, lexical substitution): (oil corrosion - corrosion caused by acidic components of oil).
- descriptive translation (to extinguish a dull polar night on the Northern Islands in the middle of summer).
- transcription and transliteration in cases where it is possible to organically include borrowing in the system of concepts of the relevant field (mettallization - metallization).

There are special requirements for a translator in the scientific field. He must not only have a good command of languages, but also be a specialist in the scientific or technical field in which he works. Also, in order to improve their skills, the translator needs to constantly improve: to learn about new products and modern developments, as well as to follow modern trends in scientific and technological progress.

Good knowledge of languages, advice from specialists in a particular scientific and technical field, a desire to know and understand what is the subject of translation, an understanding of the structure and structure of texts of scientific and technical content are the keys to successful translation in the field of technology and science.

The main task of scientific and technical translation is to bring the reported information to the reader in an extremely clear and accurate manner. This is achieved by a logically justified presentation of factual material, without explicitly expressed emotionality.

Grammatical and lexical transformations are in demand when translating texts from English into Russian. Transformations in translation are caused by the difference in the structure of languages, their grammatical categories and dictionary correspondences. There are a large number of types of transformations, as well as their classifications by various linguistic researchers. The main grammatical transformations include morphological and syntactic transformations, substitutions and permutations. Lexical transformations are most often performed with the help of

translation transcription, calcification and lexico-semantic modifications. The quantitative use of a particular type of transformation largely depends on the functional styles of speech and their genres.

Grammatical and simple lexical transformations are more widely used to translate a scientific article. Many types of lexico-semantic transformations are rarely used, due to a clear, concrete and logical style of presentation of information.

It can be concluded that the translation of special scientific literature requires a special approach and special training from the translator. The translator must possess methods, techniques and forms of scientific thinking, as well as extensive scientific knowledge and erudition. Scientific texts are difficult to translate not by their grammar and style of presentation, but by their requirements for the translator's proficiency in general scientific vocabulary and the level of knowledge in each specific scientific field, therefore, the translation of scientific literature should be considered both from the standpoint of linguistics and from scientific and technical positions.

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ANALYSIS OF TYPICAL DIFFICULTIES IN THE STUDY OF TECHNICAL TEXTS TRANSLATION IN INFOCOMMUNICATION TECHNOLOGIES.

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The training of specialists in the field of infocommunications when teaching a foreign language at a university requires the formation of certain professional skills for high-quality work in the specialty.

The novelty of this work is an attempt to analyze the difficulties common to translators and engineers in the beginning stage of training in the technical translation in the field of infocommunications.

The relevance of this work is based on the need to look for effective approaches to teaching technical translation of highly specialized texts.

The goal is to assume that it is necessary to study the vocabulary of the specialty in the early stages of training by both linguists and engineers, which will lead to confident mastery of the terminology.

For a long time, scientists did not single out technical translation in a separate category, but defined it as a subcategory of translation of special texts. There are the main problems of technical translation: the search for its place in translation studies, the terminological aspect, the problem of style in a technical text.

Today, translation of texts for the infocommunications and communication systems industry is a vast area of materials with a huge number of scientific terms and specialized vocabulary, where translation errors can become fatal. The term "translation error" is a gross inaccuracy, deviation from the standard, violation of requirements. However, a "semantic distortion" can also be

considered an error, in which a given statement will be misunderstood. In technical texts, mistakes are possible due to ignorance of the engineering discipline, when, depending on the context, the meaning of the term can change repeatedly.

To confirm the conclusions, the article "SDN-BASED SOCIOCAST GROUP COMMUNICATIONS IN THE INTERNET OF THINGS" was studied. The authors of the article are Luigi Atzori et al. [1].

Terms in the fields of infocommunications are usually formed on the basis of metaphorization mechanism. It means that those words have primary and special meaning. Modern terms used to have certain meaning, but due to technical progress they have gained new special meanings. This is the most conventional way of term formation in different fields of engineering. [1] The table below shows, how the word with primary meaning started being used as a term in the fields of infocommunication.

Table 1. Usage of the word as a term in the field of infocommunication technologies

Word	Primary meaning	Secondary (special) meaning
protocol	the official procedure or system of rules governing affairs of state or diplomatic occasions.	a set of rules that dictate how data should be delivered over the public network (Internet)
proxy	the authority to represent someone else, especially in voting.	a system or router that provides a gateway between users and the internet.

Also in the process of work, the following trends were noticed:

1. Absence of some terms in Russian:

unique identifier (GUID)

parental object relationship (POR)

social object relationship (SOR)

2. Multicomponent terms, mismatch in the number of tokens during translation:

co-location object relationship (CLOR) - *объектная взаимосвязь совместного размещения* (CLOR)

OpenFlow (OF) - протокол управления процессом обработки данных, необходимый для реализации SDN

sensor fusion - сбор и обобщение данных от средств обнаружения

3. Abbreviations:

IoT – Internet of Things – Интернет вещей

DoS – Denial of Service - отказ в обслуживании

IP - Internet Protocol - межсетевой протокол

PIM - Protocol- Independent Multicast - протокол независимой многоадресной рассылки

4. Engineering terms:

fieldprogrammable gate arrays - программируемая пользователем вентильная матрица;

flow tables - *таблица потоков*

social network of devices – социальная сеть устройств

peer-to-peer fashion - одноранговый образ/метод

Conclusions

1. Scientific and technical texts of infocommunication technologies have a number of characteristic features, stand out among scientific texts with the corresponding lexical composition. The translator must be competent in both linguistic and infocommunications, avoiding translation mistakes. The terms of this direction are variable and are constantly updated along with the development of science, requiring careful analysis for their effective and competent use.

2. The regular use of highly specialized terminology, abbreviations, non-equivalent vocabulary in texts requires the translator to be able to navigate well in the context, since it is necessary to consider and decipher all possible meanings of the original lexemes.

3. The main difficulty in the practical part of this study was caused by the translation of terminological chains, where a strict semantic hierarchy of components with semantic links is important.

4. A high-quality translation of such a text can be performed by a professional technical translator specializing in a specific area of technical knowledge, which is especially important today, when the market for specialists with the necessary training is still full [5]. It is important for future engineers to know the general technical and highly specialized terminology at a basic level.

This research requires continuation and detailed study of the topic.

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PROBLEMS OF TRANSLATION OF ENVIRONMENTAL LITERATURE

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Annotation. The paper considers the main problems of translation of environmental literature. The analysis of errors and their causes is made using examples of the translation of specialized terms from English into Russian. The consequences of these errors and recommendations for their reduction are derived.

Introduction

Due to environmental problems, such a science as ecology has become popular in the world. During its existence, scientists from different countries have made a significant contribution to the development of science, so environmental terminology has a large-scale multinational linguistic coloring. The progressive development of ecology in the last decade has led to the fact that the problems of nature protection occupy an important role in the life of every person. Environmentalists have to translate all the new English-language literature on current problems and inventions. However, in the process of translating scientific literature, with a high concentration of terms, difficulties arise that lead to the transformation and loss of meaning of this text.

Technical translation is a translation used for the exchange of special scientific and technical information between people speaking different languages [1]. This process is the communication of

specialists from different countries. Scientists exchange experience and, thanks to this, achieve technological progress. However, there are also difficulties in translating specialized literature, which slows down scientific activity.

The main problem of translation from English into Russian is a meager number of special terminological dictionaries. The need for these dictionaries is inevitably valuable, since the understanding of specialized texts is necessary for the further work of ecologists.

For a competent translation, you should pay attention to the semantic load of the text itself. This is one of the most common mistakes when translating scientific literature. As a rule, in any language there are multifunctional words, the use of which fully depends on the meaning of the sentence. In translation from English to Russian, it is difficult to find the correct meaning of a word if the translation of the word is antonymic. For example, "Ablation" in the English-Russian ecological dictionary is translated as "melting of glaciers", however, if you use other sources, then "erosion of rocks, removal" is added to this translation. [2] Making a significant mistake in similar cases may entail not only material or temporary hardships, but also endanger people's lives.

Understanding the basic information of the text helps to identify the following problems:

1) Whether the word is used in its usual meaning or in a technical one. For example: "decomposers" in a normal sentence translates as "decomposition". In the sentence "the decomposers participate in the last stage of the destruction of organic substances - mineralization, completely recycle organic matter and convert it into organic." - "The reducers participate in the last stage of the destruction of organic substances – mineralization, completely recycle organic matter and turn it into inorganic."

2) There are cases when a part of the terminological phrase has been omitted in the text, which complicates the translation. In such situations, only an approximate translation of the context helps. For example: "antipollution equipment" translates as anti-polluting equipment, but the sentence may simply use "filtration".

In addition to errors in translation, it is possible to highlight the peculiarities of the stylistics of scientific literature. It consists in the fact that it has a valid pledge and the form of the first person. Incorrect use of the pledge and the person complicates the translation and piles up so weighty text. Ecologists-specialists tend to use impersonal constructions when translating, believing that such a style is closer to scientific. However, this only takes the original meaning of the article away from the original narrative and increases the possibility of making grammatical errors.

In order to get closer to the original meaning of specialized literature, the following rules should be observed:

1. Do not start translating text, obviously not understanding the proposed topic.
2. Translate the bulk of the information, skipping complex phrases and ambiguous terms.
3. Use the necessary terminological dictionaries when translating.
4. Observe the scientific style of narration.
5. Double-check the specification of the entire text.

Conclusion

Summarizing the previous arguments, we can say that environmental literature is one of the most difficult topics to translate. Therefore, it is necessary that an ecologist not only knows the language well and has a weighty vocabulary, but also understands the meaning of the terms encountered, is able to compose a meaning close to the original, and has the peculiarity of rechecking his work.

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DIFFICULTIES IN COMPILING ONLINE TECHNICAL DICTIONARIES

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Recently much attention has been paid to the conversion of text dictionaries into the online sphere. Technical dictionaries are necessary for the exchange of knowledge and information between scientists. Technical translation means the exchange of highly specialized information between people speaking different languages. The concept includes the translation of scientific and technical materials such as: articles, reviews, monographs, manuals and documentation.

Technical translation has its own peculiarities:

1. It is necessary to observe the scientific style. It is dominated by monologue and deliberation of statements, the selection of linguistic means.
2. Spelling rules vary in different languages, so the peculiarities of each language should be taken into account.
3. Technical translation is performed in a formal and logical style. It is characterized by unemotionality, accuracy.
4. The translator must have knowledge of terminology and know different meanings of the same word.
5. The omission of semantic shades is unacceptable, since this will change the essence of the article.

To translate a technical text, you need to be an expert in the described field of knowledge. This is the only way to avoid distortions of the meaning of the text.

When translating terms, a person may face such difficulties:

- One foreign-language term corresponds to several Russian-speaking ones.
- Not every Russian word can have a similar concept in a foreign language.
- To translate technical terms correctly, it is better to use highly specialized technical dictionaries. This is the only way to achieve the greatest accuracy.

When translating a technical text, it is advisable to abandon online translators. The program performing the task will distort the text provided to it, since its task is to translate "word to word". At the same time, many scientific terms will be translated as ordinary, everyday words.

For example: the word "подшипник" is translated into English as "support", but the word "support" means technical support or maintenance.

The program will not be able to determine the exact field in which the work was performed and instead of the desired translation, it will give a more popular meaning of the word.

Online translators do not possess the subtleties of technical translation and all kinds of speech turns.

As it was mentioned above, the main thing in technical translation is to preserve and convey exactly the meaning of the given term.

Online translators are suitable only for the understanding the general essence of what is written.

To carry out scientific work, responsible technical tasks, writing international articles, it is necessary to use specialized technical dictionaries and resort to the help of the experienced translators.

УДК 811.111-26

THE INFLUENCE OF COMPUTER GAMES ON ENGLISH LANGUAGE LEARNING

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The modern world is developing at a tremendous speed. Every day a person is faced with tasks, for the solution of which it is necessary to acquire certain skills and develop new qualities. Thus, over the past ten years, English has been gaining popularity in many countries of the world and in the future can become a universal means of communication. There are many tools for learning English: online courses, books, movies, apps, online platforms, songs, and more. Along with the above, computer games cannot be ignored, which also contribute to the replenishment of vocabulary, the development of communication skills in a foreign language, the formation of a grammar and syntax base in the process of communication between players using text messages.

The relevance of the work is due to the fact that it examines and evaluates a promising approach to learning English. This method is not widely used, since it is an addition to play activities. The purpose of the work is to substantiate the effectiveness of this approach, based on the data of the survey of 1-2-year students and the analysis of the vocabulary of one of the most popular computer games Counter-Strike.

In the 21st century, our world has reached a fairly large level of progress in science, technology and innovation. This also means a change in the ways of doing life, leisure, and learning that are familiar to a person. More and more often, the latest advances in information technology are involved in the study process: video materials, articles and lectures on electronic media. All these methods are only informative, which can often cause a loss of interest in the object under study. Computer games are largely underestimated. They are believed to be purely entertaining and often extremely harmful. However, it is worth noting that there are positive aspects. I will cite as an example foreign games in which there is an interaction with a large number of players within the framework of the virtual world. Such games can be divided into two types from the point of view of "language localization" (from Lat. Locus - place) - this is the translation and cultural adaptation of the product to the peculiarities of a particular country, region or population group: full, where everything is translated and partial, where there are subtitles. The main purpose of the above types of computer games is the interaction of a large number of players online: text, voice messages. Games related to the second type (partial translation) force and stimulate to actively replenish vocabulary, learn vocabulary and grammar, since communication with players is the key to success.

Based on the above, it is necessary to find out exactly how computer games affect the learning of English. Players often turn to online translators and dictionaries to expand their vocabulary and effectively master the rules in medium-difficulty English games. For example: Counter Strike, Dota, Fallout series of games. Difficult games also expand vocabulary, since, listening to English speech and reading subtitles, willingly or not willingly, players memorize the meanings of certain words. They teach to passively and non-intrusively perceive English speech by ear. For example, Lineage 2, Time Zero series.

Let's consider learning vocabulary using the example of the English-language game Counter-Strike.

Today Counter-Strike is a cult computer game among children and older people. In April 2020, the game peaked at over 1.3 million players simultaneously. Over 850,000 users played on average, according to SteamCharts. This game involves active interaction of players through online communication. The vocabulary used in this game is words in English, denoting game terms:

Device - Device. Designation of a weapon or a sapper set.

Defuse kits — Minesweeper kit

Smoke / Smoke - Smoke. Smoke Grain

Length / Long - Long. Long, well-shot passage on the map

Middle - Middle. Central passage on the map

Plant / Plant - Plant. Place of planting a bomb or a call to teammate to plant a bomb. And many others.

It is easy to see that for successful communication it is necessary to be fluent in terms. After analyzing the vocabulary, we can conclude that computer games can be not only a way of spending time, but also a method of mastering the English language, expanding vocabulary, and improving pronunciation skills.

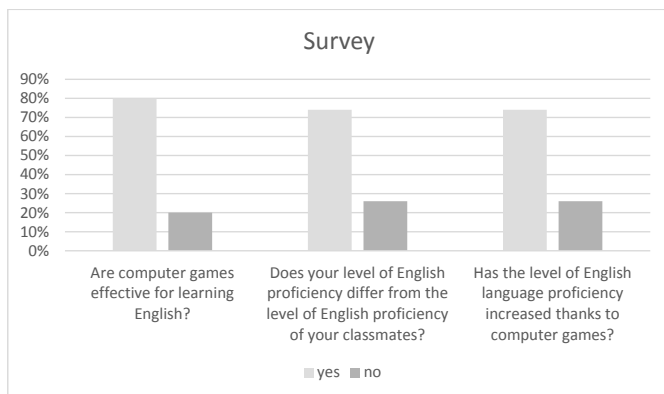
To obtain a more complete picture, we conducted a survey among the freshmen of the Kazan national research technical university – KAI (KNRTU-KAI). The survey involved 50 people.

Among them, two categories were identified:

People playing computer games in English - 74% (37 people);

People who do not play computer games in English - 26% (13 people).

The results of the survey are shown in the diagram.

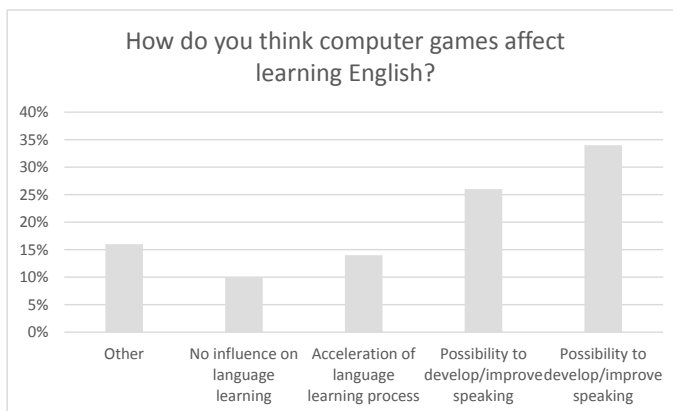


Pic. 1. The results of the survey.

Based on the presented data, we can say that the majority notes the method of learning English through video games as productive, many respondents notice positive dynamics due to this type of activity.

The question "Are computer games effective for learning English?" was aimed at analyzing and comparing the opinions of people who have experience playing computer games in English and those who have not played computer games, or have not played them at all.

The following questions are "Has the level of English proficiency increased thanks to computer games?" and "Does your level of English proficiency differ from the level of English proficiency of classmates?" were aimed at respondents who have ever played computer games.



Pic.2. The influence of computer games on language learning.

Based on the answers of the respondents, it can be concluded that the majority of the respondents note the positive impact of computer games on learning English. Many students note that their initial goal was not to study the language, despite this, one can trace positive dynamics in replenishing vocabulary, mastering the basics of grammar and vocabulary. Namely, thanks to the introduction to the gaming industry, the level of foreign language proficiency becomes much higher.

All this suggests that this method of assimilating information is not only preferable, but also productive. This means that thanks to the involvement of modern technology, students are motivated to learn English. This method is only effective when there is constant interaction between the players by text and voice messages.

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УКД 81'27

FEATURES OF AMERICAN STUDENTS SLANG*Protasov P.A.*

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American slang is unusual and unique. Slang expressions bring variety, freedom and liveliness to the language. Young people do often use slang. With the help of slang one can encrypt his or her speech so that a certain group of people can understand it. As a rule, slang is spoken by young people from 12 to 30. American students use their own slang. Unlike professional types of slang and slang of various social strata, youth slang has a great variability. The constant renewal of university students leads to a continuous renewal of student youth slang. The rapid updating of university slang increases the complexity of its study: words and expressions may already go out of active use at the time they are just recorded for the first time in dictionaries.

Currently, the Internet and social networks, which are increasingly used for communication, as an alternative to live communication, have a significant influence on youth slang, both in the United States and in other countries of the world. American students spend a significant part of their time communicating with each other through social networks (Twitter, Facebook, etc.) and messengers (WhatsUp, Telegram). Slang has become especially widespread in the world wide web: many new slang words are here to stay, since online communication requires the use of short, capacious words to save time. Many words from the Internet communication are gradually replenishing student colloquial slang, which is used in real communication of students.

The educational process is the main activity of American students and schoolchildren, they actively discuss it, use slang words. Slang related to the educational process is one of the main types that distinguish the slang of students and schoolchildren from the slang of other social groups.

Most often slang abbreviations related to the subjects and disciplines studied are encountered: "*Chem*" - Chemistry, "*Phill*" - Philosophy, "*Bio*" - Biology, "*Agc*" - Agriculture, "*Hum*" - Humanities.

The phrase "*GPA Killer*" is translated as «a very difficult subject». The grade point average (GPA) is calculated by adding student's grades in each subject and dividing that amount by the number of subjects or per semester. The GPA is a measure of student achievement at American universities. Another phrase "*RA*" means "*Resident Consultant*" or "*Resident Assistant*". The role of the RA in the hostel is played by students, usually senior ones, who enforce the rules of residence and help other students. "*All-nighter*" is a slang term for the night time spent preparing for a test or writing a scientific paper. "*Ace*" means to get the highest score. Originally, the expression was used in tennis and meant a successful pitch that the opponent is not able to hit.

The word "*dude*" is often used in the meaning of "*comrade*", "*friend*". Also, this category of words also includes the words "*wench*", which means "*girlfriend*", beloved girl. A special place among the units of slang is occupied by a rather extensive group of slang, which express directly the feelings. Most often they are short shouts such as "*chyaa!*" or "*eesh*", disagreement "*ta huh*", approval "*cool!*" or "*damm right!*"

A large group of students' slang is made up of vocabulary related to drinks and parties. For example, "*to chill*" - to relax, "*to raize da roof*" - to have a good time.

Also, a sufficient number of slang was formed by truncating the words. For example, "*za*" (pizza) is pizza, "*fam*" (family) is family, and "*rony*" (pepperoni) is sausage pizza. "*Pregame*" - a mini-party before a big party.

University slang reflects the interests and status of American students as an age and social group. Young people willingly perceive colloquial speech, and unwittingly become sources of its dissemination.

Student slang has evolved considerably since the first universities and campuses emerged. Back to medieval Europe, students often changed words and phrases in order to stand out in their own

group and maintain communication. This allows students to feel in a certain privileged position that distinguishes them from other social groups. Moreover, after graduation many graduates often use slang expressions in further communication. American students' slang can be difficult to understand and learn. It can be explained by the the following reasons:

- Setting on conversational communication, easy mutual understanding, familiarity, unpreparedness and spontaneity, the content of the conversation is not thought out in advance.
- Traditional manuals and dictionaries for the English language are usually formed not on the basis of natural colloquial speech, but often on the basis of adapted, artificially created speech. Students are taught a literary academic language, which makes it difficult to develop skills of understanding the spoken American language of its native speakers, in particular student slang.
- The trend is to increase the influence of colloquial varieties of American English with a wider inclusion of slang words and to decrease the influence of traditional American Standard English.
- Expansion of youth slang into real everyday communication, leading to a widening gap with academic English.

Thus, student slang is a kind of general youth slang, which is carried by a large and socially active group. The basis for student slang is student lingo, which is also widely used outside this subculture by representatives of other subcultures and fields of activity.

American slang of students plays the role of not only a special language that unites young people, but can also be used as a desire to name a subject or its properties in their own way.

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УДК УДК 81'25: 811.111

MODERN PROBLEMS OF MACHINE TRANSLATION IN THE DIGITAL WORLD

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The purpose of this work is to analyze the emerging semantic problems in machine translation of the text; the problems of semantic nature in machine translation are presented. The author proves that in the digital society there is an increasing need for high-quality and accurate translations of various topics and volumes.

Currently, due to the globalization of the modern world, many people feel the need for a convenient automated translator that is constantly at hand to accurately translate their thoughts. Such a need arises in business, where many companies practice international and interlingual business communication. And as for most modern people, they are trying to expand their political, cultural, social spheres of life, which is difficult to imagine without the participation of a qualified automatic translator.

Unfortunately, those computerized machine translation programs do not fully meet these needs, because it is difficult for them to take into account all the current language nuances.

In our work, we will define the very concept of machine translation and present the problems of lexical accuracy in machine translation that modern translation studies face due to the development of this type of translation.

Machine translation has two meanings in general:

1) In a narrow sense, machine translation is the process of translating text from one language to another using a computer program. At the same time, for example, by this definition of "Machine Translation", the "European Machine Translation Association" understands "the use of a computer to translate text from one natural language into another language", and the International Machine Translation Association (IAMT) defines this as the process of entering a whole sentence at a time and generating a corresponding sentence (not necessarily of good quality). That is, even in its applied meaning, there is already a difficulty in determining machine translation [3].

2) In a broad sense, machine translation is a field of scientific knowledge that is located at the junction of scientific disciplines such as linguistics, higher mathematics, cybernetics, engineering programming, etc. The purpose of this union is to build computer systems of machine translation and perform high-quality conversion of the source language into an equivalent text of the translated language [2].

In our work, we use the definition of machine translation in its first direct meaning.

Problems that arise with machine translation:

1) The problem of lexical ambiguity.

The presence of several meanings in the translated words complicates the machine translation of the text. At the same time, it is the context of the translated text that is very important. With the development of artificial intelligence, this task is being solved, but a number of difficulties still remain.

2) The problem of syntactic transformations.

Machine translation systems have the following feature: they are configured to translate individual sentences, which complicates the interconnectedness and consistency of the entire text as a whole. The reason is that it is difficult for a neural machine translation system to analyze the entire text as a whole and compactly store a large amount of source data.

3) The problem of translating phraseological expressions.

Unlike ordinary phrases, the meaning of phraseological units does not allow for word changes and does not consist of the sum of the meanings of each word. According to the translation rule, phraseological units should be translated by phraseological units or wordplay. The machine usually translates all the words verbatim. And in this respect, machine translation is inferior to the usual translation of a specialist. Thus, modern machine translation developers face such an important problem as a high-quality translation of idiomatic expressions [1].

Improving the quality of modern machine translation is a rather difficult task.

As we can see from the list of the above mentioned problems, it is more difficult for machine programs to translate a live spoken language, where it is necessary to convey the contextual situations of the language. At the same time, the more formalized the style of the source documents is, the better is the translation. That is why, the most accurate machine translations are created for technical and official-business style texts.

The processes by which the text is translated from one language to another are not directly affected, since translation is a creative and rather complex process. It requires, firstly, good linguistic training, and secondly, knowledge of the area to which the translated text belongs.

Therefore, one of the aspects of solving the problems in machine translation systems should be the problem of formalizing the mental operations of a linguistic personality with their division into stages of analysis and synthesis.

Possible approaches to improve the efficiency of machine translation systems are: the formalization and formulation of problems of system analysis and processing of textual information in natural language, as well as the development of special mathematical and algorithmic support for systems of analysis and processing of textual information in natural language.

How can we evaluate the quality of machine translation? For this, there exists a rather strict assessment of the quality of the BLEU text.

In the process of analysis, the translations produced by the machine translation system and directly by the translators themselves are compared. If a machine-written translation contains many

words and phrases in common with translations made by humans, then the system receives a higher BLEU score.

Of course, due to the great development of artificial intelligent systems, machine translation is already able to compete with the usual translation of a human specialist. And many linguists-translators in their work are also beginning to turn to an automated machine translation system.

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THE PROBLEM OF TECHNICAL TRANSLATIONS BASED ON TEXTS IN THE POWER ENGINEERING FIELD

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Currently, there is a huge trend of introducing a foreign language into the technical sciences. This is due to the fact that the ability to use a foreign language in the technical field gives great job opportunities. Due to the development of technical sciences, there is an increasing demand for translators with technical knowledge. The translator of technical literature needs to improve steadily his or her vocabulary of technical terms.

Before we get to the problem we are going to figure out what technical translation is. Technical translation is the translation of technical texts, documents, certificates, instructions, scientific and technical articles, contracts, etc. The main difficulty in such translations is the fact that translations should be as accurate as possible, since in technical texts any mistake can change completely the meaning of the context. Therefore, highly qualified translators are in great demand at the market.

Another difficulty in scientific and technical translations is the necessity to combine knowledge of a foreign language with that of technology, that is, the translator must know not only how to translate a technical term, but also what this term means in the specific areas. Therefore, the translation of technical literature requires the use of specialized dictionaries on certain branches of science and technology, such as telecommunications, radio electronics, microelectronics, etc.

The translation of texts must meet the following requirements: equivalence, adequacy, have informative value, logical and clear presentation.

In order to translate efficiently, translators need to have the lexical and practical knowledge of the foreign language structures and often narrow-profile knowledge.

Another difficulty in translating is due to the fact the translator cannot use variability. The translation style should be strictly informative and standard, for this purpose general scientific words are often used. Also, clichéd phrases, the use of professional jargon, and the absence of colloquial vocabulary can often be found in various technical texts.

One other problem of translating a technical text is the discrepancy between the requirements for possible abbreviations, which are accepted in different countries and differ in fields. Some abbreviations may be incomprehensible even to a professional technical translator.

A qualified translator should be able to synthesize technical translation techniques, know terminology and be competent in the field of technical translation, the translation should be accurate, impersonal and without any coloring. The translation process should be a kind of linguistic activity aimed at recreating completely the content and forms of a foreign text in another language.

In order to translate technical texts successfully, the translator must have a definite lexical stock, including special terms, know the grammar constructions of a foreign language, the peculiarities of dictionary creating and be able to use it, that is, to navigate in the field of scientific knowledge to which the text to be translated refers.

Here are some examples of vocabulary in the field of energy. The word "Alive" is translated as "живой", but in the electric power industry it is translated as "под напряжением". Also, for example, the term "network" has four meanings of translation: 1) Electric network; 2) Power system; 3) Circuit, circuit; 4) Multi-pole. The term transmission line has the following definition: "Electrical installation consisting of wire, cables, insulating elements and supporting structures, designed for transmission of electric energy between two points of power system with intermediate takeoff according to standards"; there is also another term "electric line which goes beyond the power station or substation and which is designed for transmission of electric energy at a distance". The term "Blocking" can be referred to as "Blocking in an electrical device," but it can also be "Blocking of an electrical product.

Thus, the main problems of translation are the accuracy of technical translations. It is necessary to have the combination of a foreign language knowledge with those of technology, it is impossible to use variability. The text must be informative and standard, to comply with the requirements for possible abbreviations.

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УДК 811

SEMANTIC REFERENCES AND EMOTIVE CONNOTATIONS OF MILITARY IDIOMS IN ENGLISH AND RUSSIAN LANGUAGES

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Phraseological units, commonly referred to as idioms in English, may stem from mythology, literature, folklore and professional occupation. For example, such arresting phrases, as 'to learn the ropes', 'to be in the limelight', 'to take your foot off the pedal'. 'to throw in the towel' take roots in sailing, acting, driving and boxing respectively. Saying that a military sphere is no less rich in eye-catching idioms than any other professional field would be putting it mildly: the military-associated metaphors have adorned different languages with a wide assortment of colorful, memorable and convincing phrases. This is not surprising, given how influential and fateful this domain is: every single armed conflict, be that an epic battle or a minor skirmish, has its far-reaching implications for all the warring parties. Having undergone the lexical processes of determinologization (when a specific initial meaning of a term fades, conceding to a new, generally understood one) and phraseologization (when, in turn, an initial lexical unit or a word combination are reconsidered with the use of a metaphor, metonymy, hyperbola, euphemism, etc), sayings from the military quit the

sociolect of the Armed forces, migrate to the national language, tap into everyday communication and become generally appropriated.

Within the confines of the given study we compare the military phraseology in English and Russian languages. To ensure a valid, transparent and easily verifiable comparison, we resort to the following criteria:

- a) a gallery of visual and verbal images;
- b) phraseological themes;
- c) semantic references;
- d) emotive connotations.

We assume that both English and Russian military idioms manifest unprecedented semantic homogeneity. This is so because any war proves to be an uttermost existential experience – either personal or generational, thus leading to a global shift from private concepts to universal, humanistic ones, such as ‘life-death’, ‘good-evil’, ‘love-hate’ and phraseological themes, inextricably related to them: conflict, struggle, endurance, willpower, courage, cowardice, moral and physical suffering, moral choice, redemption, remorse.

More than that, we deem ‘martial’ idioms emotionally rigid: regardless of any lexical transformations they expose to while transiting from a military sublanguage to everyday discourse, they maintain the original concentration of emotional coloring, inherent to the noncivilian contexts. Therefore they rarely refer to ‘casual’, ‘neutral’, ‘commonplace’ situations, serving prevalently the cases of conflicts, collisions, hardships and hazards of all stripes.

The table below considers the keynote military idioms in English.

Table 1

bite the bullet	decide to do something difficult or unpleasant that one has been putting off or hesitating over
go ballistic	fly into a rage
nuclear option	the most drastic or extreme response possible to a particular situation.
in the trenches	to be involved in ugly, dirty, dangerous things
fight a losing battle	to try to do something that one will not be able to do
pass muster	be accepted as adequate or satisfactory
stick to your guns	refuse to compromise or change, despite criticism
have a foot in both camps	have an interest or stake concurrently in two parties or sides
catch off-guard	to surprise someone, esp. in a way that makes the person feel confused or uncertain
call the shots	take the initiative in deciding how something should be done
face the music	be confronted with the unpleasant consequences of one's actions
catch flak	to be severely criticized, reprimanded
awkward squad	a set of people within an organization or team who tend to behave in an obstructive way or express opposition or dissent
space cadet	a person regarded as being out of touch with reality
running battle	a fight or disagreement that continues for a long time

It is noteworthy that none of the idioms, listed above, have positive, or, at least, neutral emotive connotations. Mainly, they have to do with such phraseological themes, as tension, distress, disturbance, misdeed, unpleasant ramifications.

Let's as well consider some major units of military phraseology in Russian language. Such phrases, as подойти на пушечный выстрел, смертный бой, под огнём критики, беречь рану, на два фронта, на передовой, принять в штыки, тяжёлая артиллерия, принять удар на себя, быть в обойме, переть, как танк, быть на взводе, выйти из строя, разбить наголову, тактическое отступление, идти широким фронтом, сложить оружие, находиться под прицелом, мобилизовать ресурсы, занять глухую оборону, перейти в наступление, пространство для манёвра, спастись бегством, сильные тылы and many others unmistakably fall into the category in question. Similarly to their English counterparts, the Russian military idioms are far from referring to joy, merriment, jubilation or happiness, acting mainly as emphatic definitives and descriptors for hard labor, crises, pressure, confrontation, troublesome incidents.

Hence, the hypothesis on semantic homogeneity of the military idioms is proven – the said homogeneity is being realized both in terms of a gallery of identical images (weapons, armament, personnel, combat vehicles, tactical maneuvers), particular phraseological themes – wrath, quarrel, conflict, suffering, endurance, furiousness and repetitive emotive connotations.

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СЕКЦИЯ 5

ФУНДАМЕНТАЛЬНЫЕ И ПРИКЛАДНЫЕ ИССЛЕДОВАНИЯ В НАУКЕ

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DESIGN AND MODELING OF AN AUTONOMOUS POWER SUPPLY SYSTEM OF A GAS TURBINE DRIVEN COMPRESSOR STATION REMOTE FROM CENTRALIZED POWER SOURCES**A.A. Abramova**

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Due to the fact that the gas production and gas transportation industries occupy not a small share in the country's economy, and oil and gas fields are located at a distance from centralized power supply systems, an urgent problem is the efficient and uninterrupted power supply of gas pumping compressor stations by autonomous power supply systems.

The development of the country's gas transportation system is ahead of the development of main electric networks, and therefore it is not always possible to connect gas transportation facilities to centralized networks. In these cases, the only option for generating electric energy is autonomous power plants. Autonomous power plants are used to supply electricity to various consumers, including consumers of compressor stations with a gas turbine drive. Depending on the type of compressor station, its electrical power consumption can range from 2 to 12 MW and higher.

The power supply of gas turbine gas pumping compressor stations of main gas pipelines can be carried out both from autonomous and from external sources of electric energy. In the presence of centralized sources, these options are competitive, because the power consumed by gas turbine gas pumping compressor stations is small.

The paper considers the power system of a gas turbine gas pumping compressor station. Centralized power systems or self-powered power plants with units running on gas or diesel fuel are used as power sources for gas turbine gas pumping compressor stations. The power units of the power plant for their own needs can be in operation (as the main source) or used as a reserve. The working and backup power sources are calculated for the full capacity of the gas pumping compressor station, i.e. each of them is able to ensure its normal technological process. The main purpose of the emergency source is to maintain the operation of the responsible electric receivers of the gas pumping compressor station for 1.5 hours and, if necessary, a forced normal shutdown of the gas pumping unit if its power supply from the main or backup source has not been restored [1].

When using a power plant for its own needs, the power supply scheme of the gas pumping compressor station forms an autonomous mini power system with characteristic fast-flowing transients. Its peculiarity is the need to take into account the special conditions for the use of general industrial electrical equipment of power supply systems in the conditions of a gas pumping compressor station [1], due to the individual properties of generating sources and consumers.

The task of autonomous power supply systems of compressor stations is to ensure uninterrupted power supply to consumers. With complete independence from external sources, it becomes possible to control the entire process of power supply of the facility, i.e. electricity generation, transportation and, accordingly, consumption. In addition, it becomes possible to fully regulate the process of electricity generation, monitor and manipulate such parameters as power factor, frequency, voltage, in accordance with the consumer requirements of the gas pumping compressor station. In modern self-powered power plants that are in operation at gas transportation facilities, heat recovery circuits involved in cogeneration process are used [2, 3].

In the schemes of autonomous power plants for their own needs, the power supply redundancy of the first category load is carried out at the expense of the loaded reserve included in the capacity of the operating power units. At the same time, at least one generator must be in operation on each bus section [4]. As a rule, the circuits of autonomous power systems of a gas pumping compressor

station are designed in such a way that the busbar sectionalizing switch is in the on-position in the normal operating period.

In the gas transportation industry, there are various types of compressor stations, the power supply of which must be carried out from autonomous power plants for their own needs [5]. Conditionally, it is possible to distinguish the difference in the power range of gas pumping units with a gas turbine drive (mainly from 16 MW to 32 MW), their number, the filling of peripheral equipment, the number and length of overhead lines. All compressor stations are built according to a typical structure, but the difference in loads can be from 2 MW to 12 MW. Therefore, there is a difference in the choice of the number and power of generator sets, as well as in the operation of the autonomous power system itself. The more units are in operation, the more in-depth study is required of the transients taking place in the power system. There are issues of synchronization of generators, stability, load distribution between sections of a closed switchgear and other issues.

Autonomous electric power systems of gas transmission systems have many positive aspects, but they also have disadvantages. The more important ones include:

- the need to install backup capacities in case of failure of all generating equipment;
- problems of stability of work, manifested both in offline mode and when working together with the network;
- complexity of switching processes occurring in emergency situations.

The design and modeling of an autonomous power supply system are aimed at studying the stability and reliability in the power supply systems of a gas pumping compressor station and choosing, based on calculations, the most suitable scheme, which will lead to increased efficiency and optimization of the existing equipment without changing the power supply schemes of facilities.

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УДК 629.735.33

RELIABLE CONTROL OF THE LANDING OF THE QUADCOPTER ON AN INCLINED SURFACE

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Abstract. This article presents a proven UAV landing control algorithm, as well as a landing platform for landing on an inclined surface. In order to use a quadcopter for this task, it is necessary to design a landing platform that will withstand external obstacles, such as wind and weight loads during landing. Conventional landing platforms with a retractor are not suitable for achieving a stable landing on inclined surfaces or obstacles. Therefore, in this article, two-link landing supports are used for a stable landing on an inclined surface or obstacle using a suitable control algorithm. In

order to achieve a stable landing on an inclined surface, an algorithm for joint control of the quadcopter and the landing platform is proposed. The proposed stable landing system consists of two controllers, that is, high-speed proportional-derivative control of the landing platform.

Keywords: Reliability, programmed route, landing on an inclined or problematic surface.

Introduction

A quadcopter is a system of unmanned aerial vehicles in which a flight is automatically or semi-automatically performed along a pre-programmed route on the ground without a direct landing of the pilot. The advantage of an unmanned aerial vehicle with a rotating wing is that it makes vertical movements up and down, hovers above the surface, in most cases when comparing types of helicopters and airplanes, which allows it to function in limited spaces. [1]

1. Reliable landing algorithm

In order for the quadcopter to land safely on a slope, it is necessary to balance the support strut along each axis. When the landing legs are controlled and balanced, it will be difficult for the quadcopter to land due to the change in center of gravity caused by the movement of the supporting legs. To solve this problem, a co-control algorithm for the quadcopter has been developed that copes with the movement caused by the supporting legs.

(Fig. 1) shows the general block diagram of cooperative control, which is divided into quadcopter and landing support control sections. The two controllers form a complementary relationship. Landing control aims to minimize roll and pitch errors that occur when the aircraft lands on an inclined surface, which can be accomplished by obtaining inverse kinematics of the four legs. The calculated error is horizontally adjusted using the proportional derivative control. The leg motor is controlled to reduce the altitude error of the quadcopter relative to the generated center of gravity, which is returned to perform altitude control of the quadcopter. The quadcopter control is designed with a PID controller (NN-PID), which quickly responds to position errors caused by disturbances occurring in real time. It can effectively control posture errors caused by environmental factors such as disturbance and wind caused by the movement of the supporting legs.

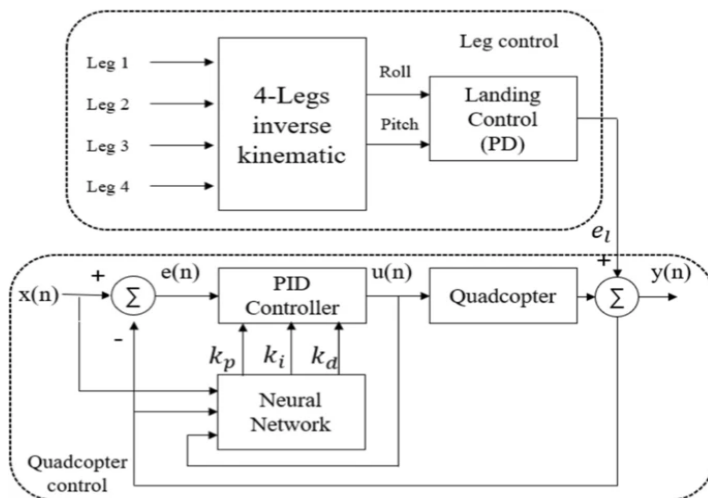


Figure 1 – Block diagram of cooperative management

There are several ways to control a quadcopter, but the most commonly used one is the PID controller. In this study, the NN-PID controller was designed for adaptive use in various situations.

Figure 2 shows an NN-PID controller for a quadcopter. The NN-PID controller continuously adjusts the (k_p , k_i , k_d) PID parameter to adjust the gain value in real time. The input signal $u(n)$ to the PID controller in the time domain can be expressed as follows:

$$u(n) = u(n-1) + k_p e(n) - e(n-1) + k_i e(n) + k_d e(n) - 2e(n-1) + e(n-2), \quad (1)$$

where $e(n) = y(n) - u(n)$, $e(n) = y(n) -$ represents an error between entering and exiting. [1]

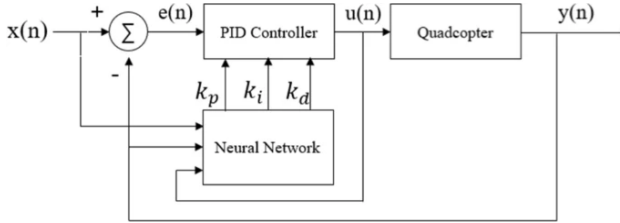


Figure 2 – Management structure NN-PID

2. Adaptive landing algorithm

The Adaptive Landing Algorithm was developed to achieve a stable landing by adapting to the ground situation using landing pads when the quadcopter was landing in a difficult ground situation. A force sensor attached to the bottom of the support leg can detect if each support axis is touching the ground; thus balancing is achieved with an inertial measurement unit attached to the quadcopter for landing.

It controls the legs on a high slope to maintain balance and monitors each leg joint by analyzing the inverse kinematics of the two-link design.

In Figure 3, in order to maintain the balance of the quadcopter, the end point A of the tilt body must be moved to B. ϕ . [2]

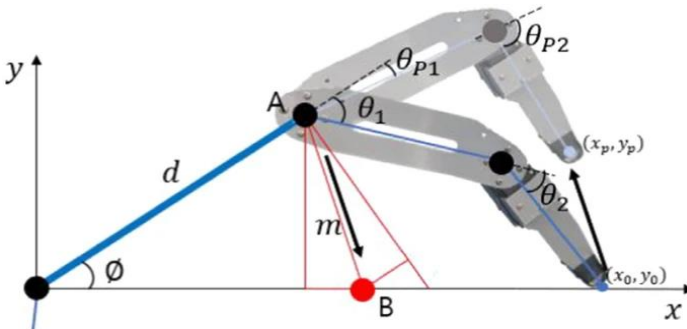


Figure 3 – Landing pad coordinate system

When the body length is d , the travel distance of the x and y axes can be obtained as follows:

$$x\phi = 2d\sin^2(\phi/2) \quad x\phi = 2d\sin^2(\phi/2) \quad (2)$$

$$y\phi = d \sin \phi \quad y\phi = d \sin \phi \quad (3)$$

The coordinates (x_p, y_p) obtained by moving the position of the end effector of the outriggers based on the x and y calculated in equations (2) and (3) are as follows:

$$x_p = x_0 - x\phi, y_p = y_0 + y\phi \quad (4)$$

The scenario of landing on an obstacle inclined at an angle of 20° can be described as three stages: (a) the landing platform reaches the obstacle, (b) leg control allows you to keep the drone in a horizontal position relative to the ground, and (c) the drone is held in a horizontal position to do not interfere with the legs.

Note that upon landing, the aircraft senses the ground through a force sensor attached to the lower leg and performs balance control when the four legs reach the ground. When the force sensor does not reach the ground, it lowers smoothly. At this time, the quadcopter descends according to a stationary flight pattern. [2]

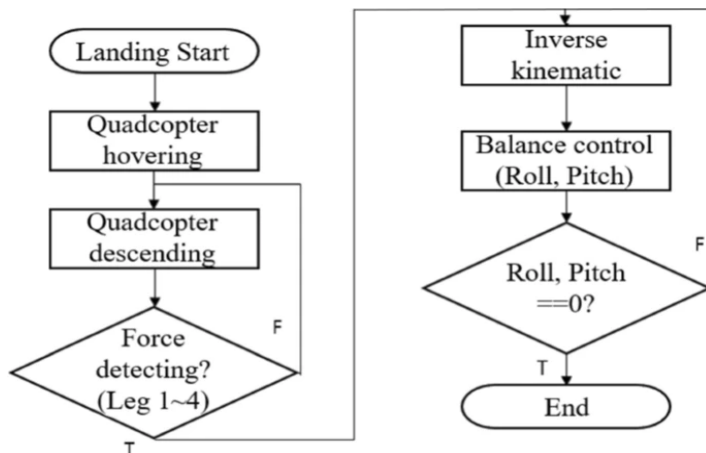


Figure 4 – Landing algorithm diagram

Figure 4 shows a block diagram of the landing algorithm. When the quadcopter tries to land after flying, it will hover first. The quadcopter will then slowly lower itself and determine if it should touch the ground through a force sensor attached to the support leg. If all the support legs are in contact, inverse kinematics is calculated, balance control is performed through a servo motor attached to the joint of each support, and landing control is completed. [2]

The article proposed an algorithm for joint control of a quadcopter and a landing platform, which has supports for landing in various ground conditions. The quadcopter was controlled by a robust NN-PID based controller to safely land on the ground against load and wind disturbances during the landing operation. An adaptive landing algorithm was also implemented for the landing platform, which provides a stable landing on an inclined surface interacting with a quadcopter.

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УДК 621.4

INCREASING OF POWER GAS TURBINE UNIT EFFICIENCY FOR NATURAL GAS BLOWER DRIVING

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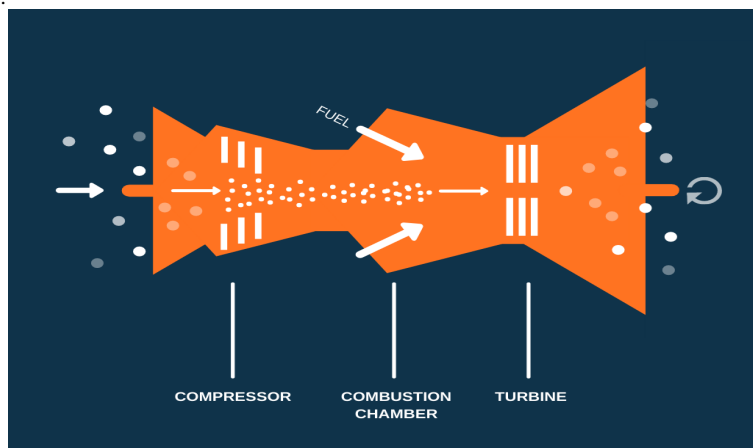
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Today, gas turbine is one of the most widely used power generating technologies. Gas turbine is a type of internal combustion engine in which burning of an air-fuel mixture produces hot gases that spin a turbine to produce power. It is the production of hot gas during fuel combustion, not the fuel itself that gives gas turbines the name. Gas turbines can utilize a variety of fuels, including natural gas, fuel oils, and synthetic fuels. Combustion occurs continuously in gas turbines, as opposed to reciprocating internal combustion engines, in which combustion occurs intermittently.

At the moment, the Russian Federation uses outdated power plants for pumping natural gas, and this could cause the problems for natural gas supply both within the country and abroad.

In 2019 Power Machines won the competition of the Ministry of Industry and Trade of the Russian Federation for the right to receive subsidies for research and development and technological works to produce high-power gas turbines. At the present day, with the support of the Ministry of Industry and Trade of Russia, "Power Machines" carry out research and development activity in cooperation with fundamental scientific research and industrial enterprises of the country.



Picture 1. Gas turbine is comprised of three primary sections mounted on the same shaft: the compressor, the combustion chamber (or combustor) and the turbine.

The purpose of this work was the creation of a more advanced engine, based on the advantages and disadvantages of the previous generation engines, to modernize the pumping process.

Gas turbine unit (GTU) is a power plant consisting of a compressor, a combustion chamber and a turbine[1]. The main principles of its operation are:

1. Compression of air in the compressor, supplying it to the combustion chamber with a certain degree of compression and with a certain flow rate.
2. Combustion of a mixture of gases in the combustion chamber.
3. Supply of a mixture of exhaust gases to the turbine, which converts the potential energy of the gases into mechanical energy on the shaft [2].

A compressor is a blade-type machine designed to compress the working gas to a certain compression ratio and supply compressed gas to the combustion chamber at a certain flow rate.

To upgrade the compressor, the following changes were envisaged:

1) It was decided to use a low-pressure compressor from a gas turbine unit from NK-16-20 (this compressor has the best design) with the introduction of technological improvements.

2) The diameter of the flow path was changed to install longer blades, which made it possible to increase (the degree of pressure increase).

In the combustion chamber, a mixture of fuel and air is burned and heat is transferred to the working air.

A turbine is a blade-type machine in which the rotor blades interact with the exhaust gases, then due to the conversion of the potential energy of the exhaust gases into mechanical energy of rotation the shaft rotation occurs.

Some improvements were made in the design of the gas adapter and the power turbine, which is used to directly transfer torque from the turbine and convert it into useful work for pumping natural gas. These improvements helped to minimize gas losses during gas transfer from the gas generator turbine to the power turbine, and also allowed the use of a power turbine with two stages, which allowed optimizing the operation of the power turbine stages.

Thus, a power gas turbine unit with a capacity of 32 MW and a gas temperature of 1300 K was designed for a natural gas blower driving. The prototype for the plant was the NK-86, but the prototype GTE 25 STA was used for the low-pressure compressor. The strength calculations of the compressor blade and the turbine disk, as well as the gas-dynamic calculations, were carried out, the geometric dimensions and the layout of the installation were determined.

Calculations on the strength of the rotor blades of the first stage of the compressor and the calculation on the strength of the disk of the first stage of a high-pressure turbine were carried out to understand the effect of changes in the design of a gas turbine engine.

In addition to calculation work and recommendations for improvements, we suggest the design of the engine, made with the use of the universal modeling system KOMPAS.

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УДК 620.181

CASTING QUALITY INPUT FOR GAS TURBINE ENGINE BLADES MADE OF HEAT-RESISTANT ALLOYS

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Abstract: the paper studies casting defects of working blades made of heat-resistant nickel alloys produced by crucible and “non-crucible” technology. On the basis of the data analysis of quality control results of these blades for 8 years, mass defect of GTE blades in the form of clogging has been revealed. The ways of improving the quality of casting blades are proposed: changing the standard technological process of casting by investment models of blades with the equiaxed structure by applying crucibleless casting technology on the plant UPF-ZM, for which it is necessary to change the layout of the furnace.

Key words: nickel heat-resistant alloys, crucible and crucibleless casting method, clogging, foam ceramic filter.

In the course of the research, a typical technological process and equipment for the casting of GTE blades have been analyzed. Blades made of heat-resistant nickel alloys VZHL12E-VI and ZHS6U-VI are cast on the following vacuum-melting units: blades made of alloy VZHL12E-VI with a directed structure are cast in through-line methodical furnaces of the PMP-2 brand, blades made of ZHS6U-VI with an equiaxial structure are cast on semi-continuous heating unit of the UPF-3M brand, which design includes a melting crucible (Figure 1).

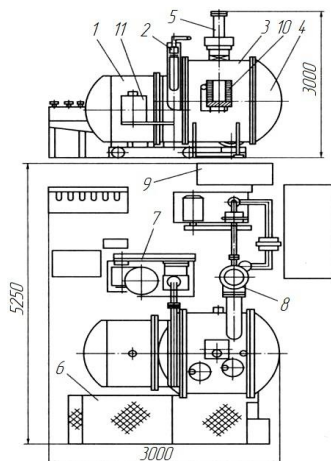


Figure 1 - Semi-continuous heating unit of USPZ-ZM

1 - sludge chamber block, 2 - shutter, 3 - melting chamber block, 4 - melting chamber, 5 - charge loading block, 6 - power supply unit, 7 - pre-vacuum pump, 8 - booster pump, 9 - power supply unit, 10 - inductor, and 11 - mold heating furnace.

In order to propose a way to improve the quality of cast blades, data on the number and type of defects in working blades made of these alloys, melted from 2013 to 2020, have been analyzed.

The results of the data analysis have shown that at the working blade made of the VZHL12E-VI alloy, which has directional crystallization, the mass type of a defect is the contamination of a product with non-metallic inclusions. Thus, frequently and in greater amounts (on average 19% of all defects) the type of defect encountered in these blades is clogging. The other types of faults (geometry, corner, model faults, spalling, oxide slabs, shape breakdown, cracks, looseness) account for only about 1%.

The figure 2 for equal-axis blades made of ZhS6U-VI alloy shows that defects such as galling also predominate and account for an average of 25 per cent of all defects. The other types of defects are only about 1-2%.

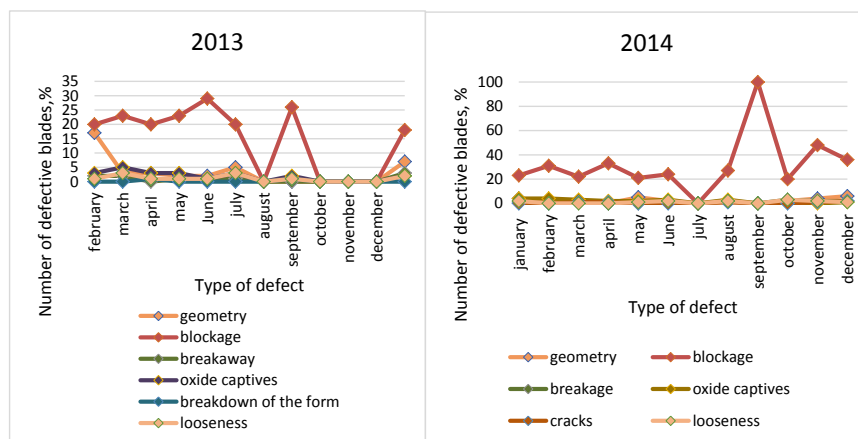


Figure 2 - Defects data for 2013 and 2014

Further, a comparative analysis of the blades obtained by crucible (blade from ZhS6U-VI) and “non-crucible” (blade from VZHL12E-VI) methods was carried out (Figure 3).

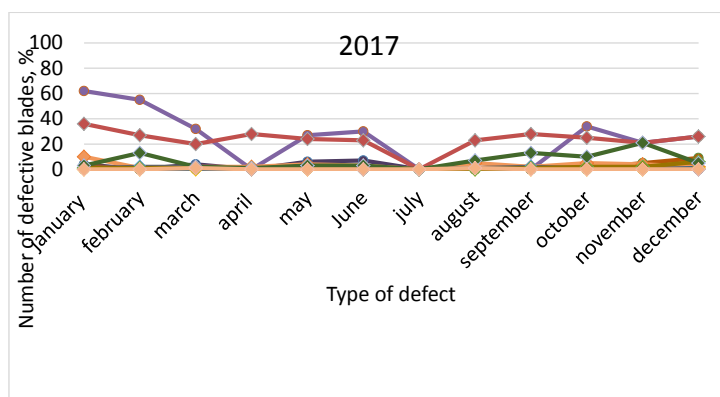


Figure 2 - Comparison of features of defect in different blades for 2017

According to the above schedule (similar to others by year of release), it can be seen that “non-crucible” casting allows to obtain blades that have a lower percentage of blockage defects than blades obtained by the crucible method. Blockage - single or group open shells on the casting surface (Figure 1).



Figure 3 – “blockage” defect

The causes of the blockage are the presence of foreign ceramic particles in the mold, the ingress of ceramic particles into the mold during pouring and the washing away of thin burrs from the lining layer of the mold by a metal jet.

The presence of the melting crucible largely determines the clogging of the metal by non-metallic inclusions, which leads to instability of the alloy properties, reducing their level and, ultimately, reducing the service life and reliability of blades [1]. Earlier published works by Kruglov E.P. suggested using a “bezel-less” technology to improve the surface quality of castings [3]. The conducted research have shown the relevance of making changes to the standard technological process. In order to implement this proposal in the case of manufacturing blades with an equiaxed structure, it is necessary to make structural changes in the UPPF-3M furnace layout unit.

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УДК 620.181

THE USE OF CERAMIC FILTERS TO IMPROVE CASTING QUALITY

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Abstract: types of defects and their quantitative indicators for several years have been analyzed, one of the main reasons of gas-turbine engine (GTE) blades defects has been determined. The ways to improve the quality of cast blades through the use of a foam ceramic filter installed in the funnel of the gate-feeding system have been proposed. Materials and designs of ceramic filters have been studied.

Key words: nickel heat-resistant alloys, GTE blade, crucible and crucibleless casting method, clogging, ceramic filter.

Gas turbine engine blades are the main components of modern aviation and industrial engines, which determine their service life and reliability under conditions of aggressive gas environment, temperature, humidity, liquid particles, dust, sand. The quality of manufactured blades crucially determines reliability and failure-free operation of gas turbine engines to a crucial degree.

The following types of surface defects are possible in the working blades of gas-turbine engines: non-filling, junctions, corbels, cold and hot cracks, oxide foams, clogging, etc.

The study considered the types of defects that do not depend on the method of crystallization, therefore data for 8 years (2013-2020) were compared for directional crystallization vanes made of the VZHL12E-VI alloy, melted at the PMP-2 plant (“non-crucible” casting) and for equal-axis crystallization vanes made of the ZHS6U-VI alloy, melted at the UPF-3M (crucible casting). It has been established that the greatest number of defects detected in castings, regardless of the equipment used, fall on the “litter”.

The analysis showed that all types of defects (geometry, corbels, model defects, spalling, oxide films, shape breakdown, cracks, looseness), except for clogging, are found in both blades in small volumes (about 1% of all defects). Moreover, these defective features occur in equal amounts both on blades made of VZhL12E-VI alloy, and on blades made of GS6U-VI. Failure due to clogging, in turn, amounts to 19% of all defects at the blade of VZhL12E-VI alloy and 25% at the blade of ZhS6U-VI alloy. We conclude that special attention needs to be paid to clogging. It is worth noting that clogging is influenced by the blade casting technology, namely the equipment used to smelt the product.

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The cause of blockages is as follows [1]:

1. Entry of molding materials into the mold cavity through cracks in the casing or cracking products.
2. Breakage or chipping out before and during pouring of the part of the mold shell that serves as the gating funnel (the upper thin, brittle edge).
3. Forming sand entering the shell cavity during molding the backing filler, calcining, pouring and transporting the molds.
4. Washing away of ceramic burrs in the mold shell by the metal jet, caused by slurry in the gap between the riser and feeder models in case of careless soldering, or between model links in case of their loosely connection.
5. Contamination of the model composition with non-metallic inclusions, sand.
6. The furnace and ladle liners have fallen into the mold.

The UPF-ZM furnace which is used for melting a blade with an equiaxed structure has a crucible in its design, and it is this crucible that is the source of clogging. Consequently, it is necessary to improve the equipment used, namely to eliminate the crucible. Such work was carried out on the territory of the plant of JSC "KMPO" by E. P. Kruglov and A. A. Snadina [2].

We propose an additional method of reducing waste by litter - refining the alloy at the stage of melting. For this purpose, it is necessary to use foam-ceramic filters (Figure 1), which will allow pre-cleaning of the alloy being smelted.



Figure 1 - Ceramic mold with foam ceramic filter installed

Various types of filters are used for in-mold filtration cleaning [5]:

- glass fibre mesh filters;

- direct-flow, in the form of ceramic plates with through holes;

These filters mechanically separate large non-metallic inclusions. They are used to clean aluminum and cast iron melts.

- granular, in the form of grains of various refractory materials located between two ceramic plates;

- open-cell foam ceramic (Figure 2).

In these filters both mechanical separation of large non-metallic inclusions and adhesive cleaning of fine non-metallic inclusions are carried out. These filters are used for alloys with a higher melting point.



Figure 2 - Foam ceramic filters

Foam ceramic filters are superior to other filters in the following properties:

- ability to delay smaller inclusions;
- reduction of metal flow velocity and formation of a laminar flow, which eliminates mold erosion;

- higher resistance to thermodynamic hammering during pouring, etc.

The use of ceramic foam filters brings advantages such as:

- reduction of defects in inclusions - by more than 50%;
- reduction of machining time - by more than 30%;
- improved mechanical properties of products - more than 10%;
- increased yield of the product - by more than 10%.

Among all types of filters used in the process of purification of the melt from non-metallic impurities, ceramic foam filters have found the greatest efficiency. The composition of the ceramic foam filter used in the casting of heat-resistant nickel alloys consists of alumina and zirconium dioxide $ZrO_2 + Al_2O_3$.

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AIRFLOW METER FOR ATMOSPHERE MONITORING SYSTEM

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Introduction

An environmentally friendly atmosphere is the most important factor in vital life activity of a person. That is why today a great importance is paid to effective atmospheric monitoring systems. Modern atmosphere monitoring systems allow people to organize a comfortable and healthy way of life.

Successful long-term operation of such systems is impossible without their accurate and high-quality setting-up of equipment and constant technical maintenance. Regular measurements of various operating parameters, including air flow measurement, also serve to determine the efficiency of the equipment.

In this work, such tasks as the development and description of the structural and functional scheme, the algorithm of the device and the time diagrams of the ion-label air flow meter are solved.

Structural and functional diagram of an ion-label air flow meter

Figure 1 shows a structural and functional diagram of an ion-label air flowmeter (ILAF) with the usage of an ion-label generator and recording electrodes [1]. The air flowmeter for the atmosphere monitoring system measures the air flow velocity, on the basis of which the volumetric air flow is calculated, which makes it possible to optimize and achieve more efficient performance of the atmosphere monitoring system, which in turn organizes comfortable human life, informing users about the state of the atmosphere or air in the room where this system is located.

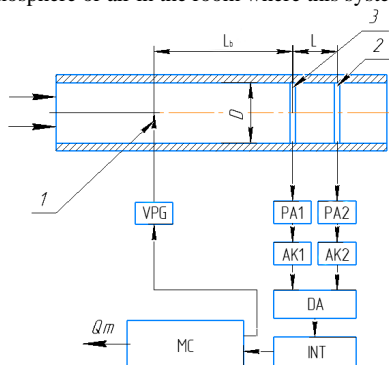


Fig.1. Structural and functional scheme of ILAF.

The electrodes of the recorder are made in the form of insulated rings with a diameter equal to the diameter of the flow channel and are located from each other at a distance equal to one and a half of the radius of the flow channel.

Thus, the functional diagram of the ion-label airspeed meter (Fig.1) contains a flow channel in the form of a tube with a diameter D , in the input part of which there is a spark gap 1 connected to a high-voltage pulse generator (VPG). Along the course of the air flow in the flow channel, two isolated annular electrodes 2 and 3 of the ion label recorder are located at a distance ΔL relative to each other. In this case, the diameter of the electrodes is equal to the diameter of the flow channel,

and the placement distance from the spark gap to the first electrode 2 is $L_b - \Delta L$, where $\Delta L = 1.5R$ (R is the radius of the flow channel) [2]. The electrodes 2 and 3 through the pre-amplifiers PA1 and PA2 and the analog keys AK1 and AK2 are connected to the differential amplifier DA, whose output is through the integrator INT. The output of the comparator is connected to the input of the microcontroller (MC), the control output of which is connected to the VP generator. With MK, we receive a ready-made information signal Q_m on gas consumption.

Description of the structural and functional scheme of the ion-label gas flow sensor

The airspeed meter works as follows. In accordance with a given program, the MC generates pulses at a certain frequency at the control output, which trigger the PG label generator. A short high-voltage pulse enters the spark or corona spark gap and causes a spark or corona breakdown, respectively. As a result of the breakdown in the vicinity of the spark gap, the air is ionized, and ions with an electric charge are formed, thus an ion label is formed, which moves along with the air flow [3].

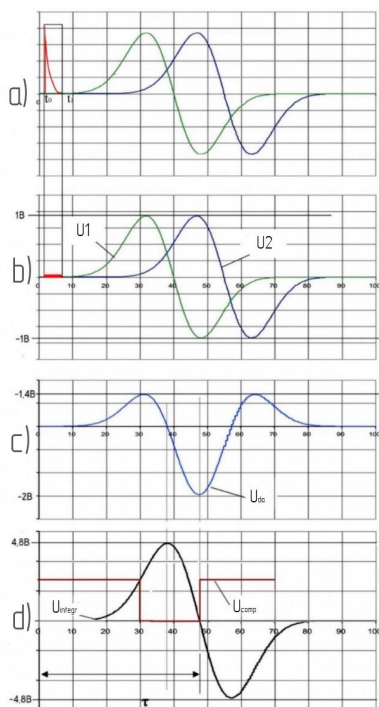


Fig. 2. Time diagrams

It leads to when a charged ion label passes near the electrode 2, a current pulse is induced on the latter, which is amplified by the pre-amplifier PA1. The pulse U_1 at the output of PA1 has the form shown in Fig.2 b. A similar pulse U_2 is formed at the output of PA2, but since the electrode 3 is separated from the electrode 2 at a distance of ΔL , the pulse U_2 has a corresponding time delay relative to the pulse U_1 . Analog keys AK1 and AK2 allow at time t_0-t_1 (duration approximately 200ms) to open the circuit to eliminate interference with the PA at the input of the remote control (Fig.2 a). Next, both pulses are fed to a differential amplifier, at the output of which a signal of difference $U_1 - U_2 = U_2$ is formed (Fig.2 c). This signal is led to the INT integrator, the output signal of which U_{integr} (Fig.2 d) is supplied to the MC with a built-in comparator. The comparator fixes the temporary position of the intersection point with a zero-level U_{integr} signal. Next, a time

interval is formed, the beginning of which corresponds to the moment of generation of the ion label, and the end to the moment of crossing the boundary of the base distance L_b , which is located between the electrodes 2 and 3 at an equal distance from them $0.5 \Delta L$. According to the duration of the time interval τ in MK, the air flow velocity $V = L_b / \tau$ is calculated. The measurement result is stored in the memory of the microcontroller.

Thus, in this work, a structural and functional scheme was developed and the algorithm of the device operation and time diagrams of the ion-label air flow meter operation are presented.

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SCHEME OF CONSTRUCTION OF FUNCTIONAL UNITS OF ION-LABEL AIR FLOWMETER

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Introduction

To solve the problems of measuring the air flow velocity, the most promising converters are based on unipolar ion labels, which represent local area of the air flow with an increased concentration of unipolar ions formed as a result of a short-term spark discharge produced in the incoming flow. This label can be formed in a small amount of flow, and its gas-dynamic properties practically do not differ from the properties of the air medium, which ensures full compliance of the parameters of the movement of the label with the characteristics of the airflow.

An important advantage of unipolar ion tags is the possibility of their registration by a non-contact method, namely with the help of metal electrodes, on which, due to the effect of electrostatic induction, a pulse signal is induced during the passage of a charged label. In this case, the electrodes can be isolated from the flow by a dielectric material, which ensures high reliability of the converter when exposed to moisture, dust, etc. [1]

The paper considers the features of the circuit design and selection of the element base of the functional units of the ion-label air flow meter.

Ion Label Generator

It is advisable to construct a high voltage pulse generator according to the scheme shown in Figure 1 [2]:

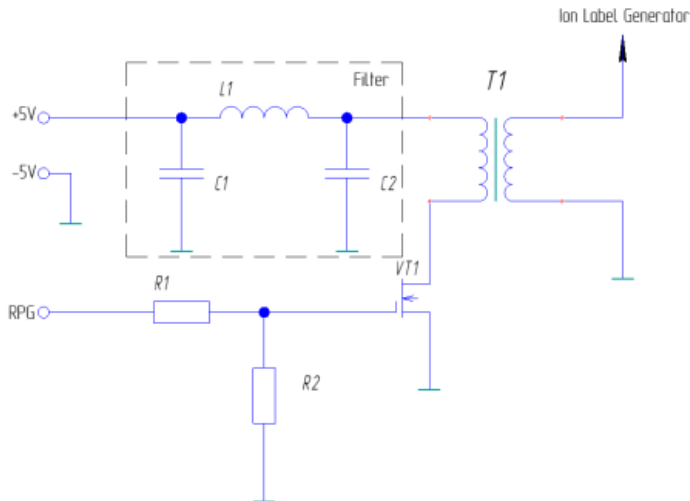


Fig.1 Generator of high-voltage pulses

In Table 1 the specification of generator elements is shown:

Table 1. Specification of generator elements

Designation	Name
C1	Capacitor K10-17B-N90-1UF±20%
C2	Capacitors K10-17B-Y5V-4.7 UF=20%
R1	Resistor CF -25-0.25-470 Ohms ±5%
R2	Resistor C2-23-2-100 kOm ±5%
T1	Transformer
VT1	Transistor IRLML6344TRPBF-N-channel-30V-5A

Analogue key

The analog key is required to open the circuit at the start of the measurement in order to eliminate interference from the control unit at the remote control input. 2 analog keys are needed. To reduce the dimensions, we use a two-channel precision analog key with a single-pole power supply MAX325CPA. The pinout is shown in Figure 2:

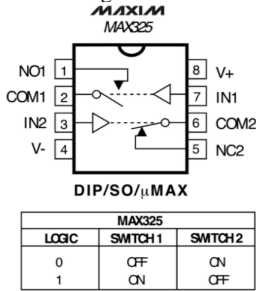


Fig. 2 Pinout of the analog key

COM1 and COM2 are switches, inputs IN1 and IN2 get signals from recorders, output signals will come from ports NO1 and NC1.

Label Logger

The electrical diagram of the recorder is shown in Figure 3. Terminals 1 and 2 are connected to the recording electrodes. The signals coming from the recording electrodes pass through the pre-amplifiers, which must be sensitive to these signals. [3]

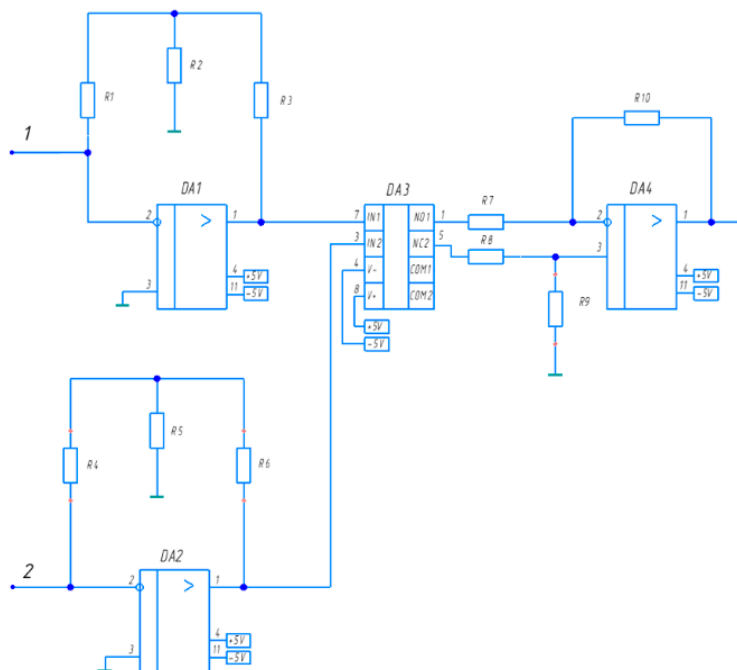


Fig.3 Label recorder.

Therefore, it is necessary to select operational amplifiers DA1 and DA2 with a large input impedance. To reduce the overall dimensions, we will focus on the operational amplifier K140UD12. The DA3 key is connected to the microcontroller via ports COM1 and COM2. It controls the incoming signal.

The K140UD12 is a quad micro-power operational amplifier designed to operate in a wide voltage range from a single power source. It is also possible to work from a source with bipolar power. The IP contains:

- Current stabilization scheme with the start-up circuit;
- Four independent operational amplifiers

On Figure 4 K140UD12 is shown :

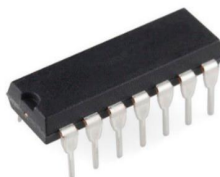


Fig.4 Housing 401.14-5M. Part type K140UD12

Features of K140UD12:

1) Voltage range of the power supply:

- Unipolar power supply $3 \div 32$ V

- Bipolar power supply ± 1.5 V $\div \pm 16$ V

2) The output voltage is consistent with all types of logic circuits

3) Operating temperature range: $- 60$ °C $\div +125$ °C

Integrator

Figure 5 demonstrates the integrator:

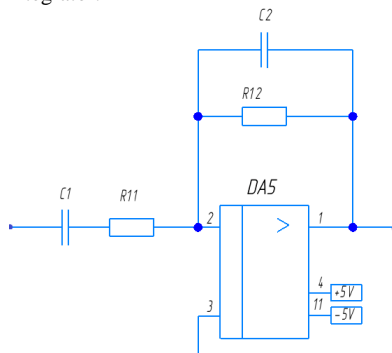


Fig.5 Integrator

The voltage U_1 and U_2 from the outputs of the amplifiers DA1 and DA2 are supplied to the inputs of the differential amplifier DA4. The difference signal from the output of the differential amplifier goes to the DA 5 integrator, which is a low-pass filter.

Thus, we have technically implemented an ion-label air flow meter. We were able to achieve energy, economic and dimensional efficiency.

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DEVELOPMENT OF MEASURES TO REDUCE EMISSIONS OF POLLUTANTS INTO THE ATMOSPHERIC AIR DURING PERIODS OF UNFAVORABLE METEOROLOGICAL CONDITIONS FOR ENTERPRISES I, II, III CATEGORIES**Vasileva M.A.**

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The interactions between humans and their physical surroundings have been extensively studied, as multiple human activities influence the environment. The environment is a coupling of the biotic and the abiotic.

Pollution is defined as the introduction into the environment of substances harmful to humans and other living organisms. Pollutants are harmful solids, liquids, or gases produced in higher than usual concentrations that reduce the quality of our environment.

Human activities have an adverse effect on the environment by polluting the water we drink, the air we breathe, and the soil in which plants grow. Although the industrial revolution was a great success in terms of technology, society, and the provision of multiple services, it also introduced the production of huge quantities of pollutants emitted into the air that are harmful to human health. Without any doubt, the global environmental pollution is considered an international public health issue with multiple facets. Social, economic, and legislative concerns and lifestyle habits are related to this major problem. Clearly, urbanization and industrialization are reaching unprecedented and upsetting proportions worldwide in our era. Anthropogenic air pollution is one of the biggest public health hazards worldwide, given that it accounts for about 9 million deaths per year [1].

Air pollution has various health effects. The health of susceptible and sensitive individuals can be impacted even on low air pollution days. Short-term exposure to air pollutants is closely related to cough, shortness of breath, wheezing, asthma, respiratory disease, and high rates of hospitalization.

The long-term effects associated with air pollution are chronic asthma, pulmonary insufficiency, cardiovascular diseases, and cardiovascular mortality. According to a Swedish study, diabetes seems to be induced after long-term air pollution exposure. Moreover, air pollution seems to have various malign health effects in early human life, such as respiratory, cardiovascular, mental disorders, leading to infant mortality or chronic disease in adult age.

To date, various methods are used to assess the quality of atmospheric air, such as the study of depositing media, methods of mathematical modeling, the use of information technology, interpolation and mapping. Air quality monitoring is carried out by instrumental and calculation methods. The use of calculation methods to determine the surface concentrations of emission components from pollution sources will automatically determine the points where the maximum permissible concentration (MPCs) is observed, as well as find the sources of the greatest contribution to pollution in the residential area. To calculate the concentrations of a wide range of emission components, the UPRZA program "Ecologist - City" is used. In the calculation results, the values of surface concentrations at the calculated points are given in mg / m^3 or in fractions of the MPCs. These values are summarized in special tables. Formation of maps of isolines of surface concentrations of pollutants on the ground in a given scale is carried out according to the results of the calculation [2].

Due to climatic, geographical and other features of the area, natural phenomena, a period of unfavorable meteorological conditions begins. According to Article 1 of the Federal Law "On the Protection of Atmospheric Air", unfavorable meteorological conditions are meteorological conditions that contribute to the accumulation of pollutants in the surface layer of the atmosphere.

According to the Order of the Ministry of Natural Resources and Environment of the Russian Federation dated November 28, 2019 №811 "On approval of requirements for measures to reduce

emissions of pollutants into the air during periods of unfavorable meteorological conditions": Development of measures under unfavorable meteorological conditions is carried out for all emission sources subject to standardization in the field of environmental protection.

Using the example of the enterprise "N", the main activity of which is the provision of electricity, which has category 3 of the object of negative impact on the environment, the calculation of dispersion of concentrations of pollutants has been made. In the course of the enterprise's activity, 27 types of pollutants are identified, 4 groups of substances have a summation effect, 18 emission sources (7 organized) with a total mass of 0.358015 t / year as a whole for the enterprise (0.658702 g / s).

According to clause 11, of the Order of the Ministry of Natural Resources and Environment of the Russian Federation dated November 28, 2019 №811: to compile a list of substances, the results of calculations of dispersion of emissions are analyzed, values and control points are determined at the border and on the territory of the residential zone and special zones, to which are subject to increased sanitary and epidemiological requirements for atmospheric air in urban and rural settlements, as well as the contributions of emissions of specific stationary sources to ground-level concentrations (in percent) at control points are calculated.

For cases of an increase in the values of the calculated concentrations at control points by 20%, 40% and 60%, such values are compared with the MPCs of the corresponding pollutants.

The calculated surface concentrations were made using the UPRZA program "Ecolog-Gorod" version 4.60 [3]. Thus, Table 1 shows the concentrations for a number of standardized pollutants with the highest concentration.

Table 1

Pollutants		Max. concentration, fraction MACs	Max. concentration outside the territory the object of negative impact with increased		
code	Name		на 20%	на 40%	на 60%
1	2	3	4	5	6
0143	Manganese	0,37	0,444	0,518	0,592
0301	Nitrogen dioxide	0,51	0,612	0,714	0,816
0304	Nitric oxide	0,01	0,012	0,014	0,016
0330	Sulphur dioxide	0,22	0,264	0,308	0,352
0333	Hydrogen sulfide	0,001	0,0012	0,0014	0,0016
0337	Carbon monoxide	0,06	0,07	0,08	0,10
0342	Fluorochemical products	0,04	0,05	0,056	0,064
1325	Formaldehyde	0,008	0,0096	0,0112	0,0128

The calculation of dispersion for all substances did not show an excess of more than 1 MPCs at the industrial site, at the border of the sanitary protection zone, and more than 0.8 MPCs for residential and residential areas. But during unfavorable weather conditions, with an increase of 60%, an excess of nitrogen dioxide concentration is observed, which obliges the enterprise to take measures to reduce emissions during this period.

Nitrogen dioxide is an oxidizing free radical which can initiate a variety of destructive pathways in living systems. Nitrogen dioxide causes a range of harmful effects on the lungs, including: Increased inflammation of the airways; Worsened cough and wheezing; Reduced lung function; Increased asthma attacks; Greater likelihood of emergency department and hospital admissions. A large study found evidence that people with lung cancer faced greater risk from NO₂, ozone, and other outdoor air pollutants [4].

Thus, according to the analysis of the calculation of the dispersion of pollutants, with an increase in the calculated surface concentrations of pollutants created by the emissions of the object of negative impact, at control points by 20%, 40% and 60%, the excess of the hygienic standards of pollutants in the atmospheric air is not observed, and according to cl. 12 of the Order of the

Ministry of Natural Resources and Environment of the Russian Federation of November 28, 2019 №811 "On approval of requirements for measures to reduce emissions of pollutants into the air during periods of unfavorable meteorological conditions", it is required to develop measures to reduce emissions of pollutants into the air during periods unfavorable meteorological conditions.

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УДК 004.942

DEVELOPMENT OF ALGORITHMIC SUPPORT AND SOFTWARE FOR KINEMATIC DIAGNOSTICS OF VERTICALLY INHOMOGENEOUS MEDIA BASED ON THE MEASURED SCATTERED ACOUSTIC SIGNAL UNDER CONDITIONS OF LINEARIZATION OF THE VELOCITY FUNCTION OF THE PROBING SIGNAL

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The dissertation work refers to the scientific problems of remote study of vertically inhomogeneous media, such as the World Ocean, the Atmosphere and, in some cases, the Earth. It is known that in these areas of research, the density of their matter increases with depth, and thus the propagation speed of acoustic and seismic waves increases, which in the ray approximation (the approximation of acoustic optics) provides such a physical phenomenon as refraction. Refracted waves serve as an effective tool for remote sensing of their propagation media.

Remote sensing with mean acoustic sounding is problematic when the velocity distribution allows linearization of the velocity function at depth. The solution to this problem can be useful in such areas as acoustic tomography of the Ocean, acoustic sounding of the atmosphere, diagnostics of the Earth's interior in areas of deep sediment of accumulations.

The mathematical formulation of the thesis problem refers to the inverse problems of mathematical physics and is a variant of the inverse for the Fermat functional, where the velocity distribution of the used wave signal in the medium under study is determined by the time of arrival of refracted waves. This problem belongs to ill-posed problems of mathematical physics and requires special methods of regularization for its solution. In the formulation under consideration, this problem has a degree of incorrectness as in the problem of differentiating a table-defined function, and the solution is regularized by smoothing the measurement vector, for example, by splines. During the experiment, the information-measuring system uses sources and receivers in a narrow beam pattern with subsequent computer processing of the measurement data. The response of the investigated medium to the acoustic impact is the signal scattered by inhomogeneities.

Thus, in this case, the working signal is scattered-refracted waves propagating along their ray paths (geodesic). The problem solved in the dissertation work can be called as "Inverse kinematic scattering problem". On the basis of the constructed solution and its computational algorithm, a software implementation will be compiled, a study of noise immunity, resolution, and the limits of applicability of the algorithm will be carried out; a recommendation for conducting an experiment

has been developed. The created software was transferred to the fund of algorithms and programs in the form of a computer complex.

УДК 621

COMPARISON OF LASER AND VOLUME HARDENING WITHIN EXISTING METHODS OF THE PROCESS

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Hardening is a heat treatment process consisting of heating the metal to a temperature above the phase transformations, holding at this temperature and cooling at a rate higher than critical. The purpose of hardening is to obtain a martensitic structure and consequently to increase the hardness, strength and wear resistance of the material. Hardening is a twofold process: heating and cooling. The technology determines the different properties that can be obtained. Therefore, the paper considers the following hardening processes: bulk hardening, high frequency hardening (HF hardening) and laser hardening.

Bulk hardening is the most common method of thermal hardening of materials. This type of hardening is characterized by: low costs, simple technology and no need for special preparation of the part. The disadvantage of bulk hardening is the need for tempering, which reduces the hardness. In addition, hardening leads to the formation of scale on the surface of the part.

Although bulk hardening was invented a long time ago, the modernization of this method does not stop to this day. For example, it has been proposed to use waste products such as coconut water or waste engine oil as quenching medium for medium carbon steel. The article "Exploring the microstructure and tensile properties of cold-rolled low and medium carbon steels after ultrafast heating and quenching" [1] studies the effect of heating rates on the microstructure and properties. Structural analysis has revealed that grain refinement has a negligible effect on yield and ultimate tensile strength compared to the relative distribution of the microstructure. It is suggested that the interaction of various reinforcement mechanisms in the samples is responsible for the observed increase in strength and ductility.

For large parts, the use of volumetric hardening is not rational. For these applications high-frequency hardening is used, which has high productivity and automation. An important advantage of high-frequency hardening is that the volume change associated with structural transformations, and therefore the change in dimensions of the workpiece can be more or less accurately taken into account. The main disadvantage is the difficulty of manufacturing the inductor. Article "Effect of spot continual induction hardening on the microstructure of steels: Comparison between AISI 1045 and 5140 steels" [2] shows the structures of AISI 1045 and 5140 steels after continuous spot induction hardening (SCIH). The result was that the SCIH with a relatively low feed rate is more suitable for improving the mechanical properties of materials.

Laser surface hardening has several advantages over bulk hardening. After laser hardening, a technological tempering operation is not required and permanent deformations are practically eliminated. In addition, this method avoids defects caused by thermal stresses through local heating. However, this technique also has a number of drawbacks: the depth of the hardened surface is limited, and cleaning of the surface from rust is also necessary. Typically this method is used for edge hardening of cutting surfaces [3].

The process of laser hardening of a part is to be considered in more details. Before processing the part, a special paint is applied to the surface to be hardened, the function of which is to absorb the laser radiation. It adheres to the metal and is the bottom layer. Next, a transparent layer - water - is applied. The laser beams are then directed onto the part, and they pass through the water to begin

evaporating the lower layer, i.e. the paint. The water at this time prevents the sudden formation of gas from the evaporating bottom layer. This causes all the energy of the resulting gas to go towards the metal. High heating and cooling results in fine surface structures and also improves the physical and mechanical properties of the part surfaces. Often, a single laser treatment of the surface is sufficient to form the final properties. The hardening effect is achieved both with processing without surface melting and with the formation of a melt pool on the material surface, the crystallization of which forms a hardened layer [4].

In the article "Laser treatment as a promising method for increasing wear resistance of metal cutting tools" [5] the effect of laser processing on the wear resistance of a metal-cutting tool were studied. The study revealed a number of disadvantages of laser application, namely, the metal-cutting tool material could be machined to a limited depth and the laser had a low coefficient of efficiency. Separately, the high cost of laser installations and complexes was noted.

In "Hardening of high-speed steel using laser hardening and laser tempering" [6], it was found that in high-speed steels laser hardening allows to dissolve large carbides, to obtain the structure of solid solutions of martensite and austenite, and the subsequent laser tempering eliminates residual austenite.

In "Influence of pulsed laser processing of hard-alloy cutting tools on the efficiency of metal cutting" [7] the efficiency of pulsed laser processing (PLP) in metal cutting machining was studied. As a result of the study, it was found that laser processing contributed to 1.4-2.5 times increase of optimum durability of cutting tools. The researchers found that the tools had more stable properties after ILO. A reduction in the coefficient of variation of durability was observed, as well as a reduction in the probability of failure.

The possibility of using machining after laser heat treatment was investigated in "Mechanical treatment of the surface layer of the steel-copper pseudo-alloy subjected to laser heat treatment" [8]. For this purpose, the surface layer of the steel-copper pseudo-alloy was first subjected to laser heat treatment and then to mechanical treatment. During the experiment it was found that the surface was hardened by laser depending on the mode to 50-62 HRS (conventional heat treatment allows to obtain only 45 HRS). Turning was used to remove the maximum allowance of the hard melted layer, and grinding was used to obtain a high quality surface with low roughness. This work has proved that machining of surface layer of steel-copper pseudo-alloy parts after laser heat hardening is possible, but requires the use of tools with increased resistance.

Thus, laser hardening has a number of advantages and disadvantages compared to traditional hardening methods. The development of new technologies with the use of laser will open up new possibilities for the use of parts and assemblies, and will help in the development of technology.

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УДК 621

LASER CLADDING METHOD IN WORN PARTS REWORKING

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In modern conditions, one of the main objectives of a company is to reduce the cost of its products. To achieve this, various methods can be used, for example, reclaiming worn parts and assemblies of equipment. This will save money on replacing parts, as well as offsetting the cost of the metal for remelting.

The following methods are widely used for restoration of parts: sputtering of metals, their alloys and polymers, restoration by electrolytic deposition, manual and mechanized surfacing and welding. Laser surfacing is one of the most promising methods among many others for the restoration of worn surfaces.

Laser cladding is a method of applying a material using a laser beam to create a pool of melt where the material is fed. Both powders and wires can be used as additives [2]. This method is used to restore worn or damaged surfaces of parts in the power, engineering and oil and gas industries. The process of laser cladding is to be considered in more details.

Using a nozzle and gas, powder material is directed onto the surface of the part. The laser radiation melts the powder and the layer of metal on the workpiece. The laser head moves over the surface of the part and creates a cordon (ribbon coating) on it [8]. The physical and chemical properties of the deposited layer are determined by the powder material. However, the power density in the laser spot, the powder mass flow rate in the jet and the scanning speed over the surface affect the quality of the coating and its homogeneity.

Thanks to laser cladding, it is possible to create coatings that are resistant to oxidation, wear and corrosion at high temperatures [7]. This fact allows to use surfacing for repair and restoration of expensive parts, creation of products with special properties.

Laser cladding has a number of advantages over other methods. For example, laser cladding allows rapid part refurbishment due to the high powder feed at high laser movement speeds, which is due to the high energy density in the heating spot [5]. This method allows to control the microstructure and functional properties of the coating due to the minimization of the mixing zone between the coating material and substrate and the zone of thermal effect [6]. The possibility of obtaining thin layers is noted, as well as small deformations of the clad parts. Cladding of hard-to-reach surfaces is singled out [3].

The disadvantages are low productivity, low process efficiency and complicated and expensive equipment [3].

Laser technology is being actively researched and applied. The process of creating new additives is rapidly developing, with particular attention being paid to various powders. For example, in the article "NiCrBSi coating obtained by laser cladding and subsequent deformation processing" [9], a group of researchers developed a Ni-Cr-B-Si coating obtained by laser cladding and subsequent deformation processing. They noted an increase in wear resistance, surface hardening and reduction of residual stresses.

The article “Investigation of the porosity of coatings from cobalt and nickel alloys deposited by laser radiation” [1] studies the porosity of cobalt and nickel alloys, deposited by laser radiation. Cladding of alloys was carried out by 2 methods: pulsed and continuous radiation. As a result, it was found that the porosity of the coatings obtained by pulsed irradiation was less than that of coatings obtained by continuous radiation (<1% and <2.2%, respectively). The researchers found that cobalt alloy coatings exhibited higher porosity than nickel alloys.

In article “Investigation of laser cladding of cast iron by feeding PG-FBK_h-6-2 powder into the reflow zone” [10] laser cladding of cast iron with PG-FBX-6-2 powder in the fusion zone was investigated. As a result, it was found that in the areas with the most complete dissolution of the graphite plates an austenitic-martensitic structure (hardness 8.0-9.5 GPa) is created, and in the areas with little dissolution a martensitic-sorbite structure (hardness 6.5 - 7.0 GPa) is created. At the same time, laser treatment has made it possible to increase the hardness of cast-iron clad parts by 3-4 times, as well as to significantly increase wear resistance.

The paper “Development and research of the process of volumetric shaping from metal powders under the influence of pulsed-periodic laser radiation” [4] studies the process of bulk cladding of Ni-Cr-B-Si filler powder using pulsed-periodic laser radiation and establishes the relationship between laser cladding mode parameters and geometric parameters.

Thus, laser cladding is already considered one of the most promising methods for restoring various worn parts. In the near future, new additive application methods will be available, equipment will be improved and new powders will be created.

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THE RESEARCH OF CARDIAC CYCLE ONSET POINT DETECTION FOR TELEMEDICINE APPLICATION

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The most frequent reason of death (including sudden death) in Russian Federation is cardiovascular diseases [1]. That is why electrocardiosignals (ECS) analysis in telemedicine is very relevant.

ECS main elements are P-, Q-, R-, S-, T-waves, which are shown at Fig. 1.

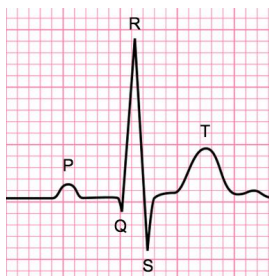


Fig. 1. ECS components.

Each element reflects a certain heart functional process. Particularly, P-wave characterizes atria functionality. This field is very important because various atrial abnormalities, for example, atrial fibrillation (AF – ECS amplitude chaotic change), can lead to health problems. Nielsen J.B. et al. in study [2] researched correlation between P-wave duration and AF risk development. Sample size was 285933 persons, average analysis period was 6,7 years. As a result of the study, authors formed a conclusion that even insignificant P-wave duration deviations increase the probability of AF. Lenis G. et al. in study [3] noted importance of P-wave analysis not only in AF risk evaluation but also in treatment from AF. Marsanova L. et al. in study [4] pointed on importance of P-wave correct detection in ECS automatic analysis.

The main goal of this research is to test the ability to detect P-wave onset point. 10 ECS records by I standard lead (from hands) were analyzed for this work. Main advantage of I standard lead is ease of ECS registration. ECS were taken from St Petersburg INCART 12-lead Arrhythmia Database, open-access Internet source Physionet [5]. Analyzed ECS duration - 1 minute, sampling frequency - 257 Hz. In most ECS records we analyzed 50 P-waves. Thus, in this study we realize an algorithm for P-wave onset point detection in according to beat-to-beat analysis. Overall, we analyzed 489 P-waves. We used MATLAB program product for ECS analysis.

Signal preprocessing included filtering to reduce low-frequency baseline noise and high-frequency noise, that is why we designed filter in Filter Designer app. For this study we designed bandpass 666-order filter with finite impulse response (FIR). FIR filters are always stable, that is why we designed an appropriate filter. We selected filter order with the purpose to suppress noises as much as possible. Filtering frequency range - $1 \div 10$ Hz. We selected this frequency range to minimize noises level. Thus, designed algorithm for P-wave onset point detection is tested under conditions of minimal noise impact. An example of analyzed ECS after filtration is shown at Fig. 2.

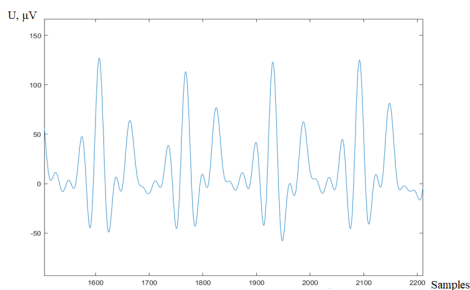


Fig. 2. ECS without noise.

Closest minimal voltage value before P-wave was selected as a preliminary reference point. We analyzed sectors as reference point ± 10 samples. Thus, analyzed sectors duration ≈ 82 ms (Fig. 3).

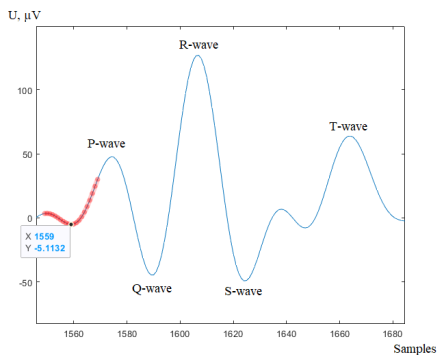


Fig. 3. Reference point and analyzed area.

We proposed analyzed sectors second derivative as detection criterion (equation (1)):

$$U''(t) = \frac{d^2U}{dt^2}, \quad (1)$$

where dU is ECS voltage change, dt is time (samples) change.

The meaning of second derivative is curvature analysis. If second derivative maximal at some point, curvature value highest at this point. We consider this point as P-wave onset point (Fig. 4).

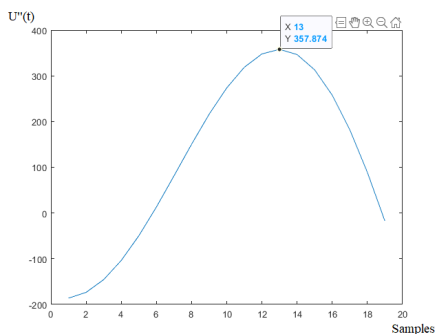


Fig. 4. Second derivative function.

Within one ECS record we analyzed 44÷50 areas. The more often a point was second derivative maximum, the higher probability was that this point is P-wave onset. Results of research are shown in Table 1.

Table 1. Results of the analysis of the algorithm.

ECS record	Duration from reference point to P-wave onset, samples (ms)	Probability, %
1	2 (7,7)	52
2	2 (7,7)	56
4	2 (7,7)	56
5	1 (3,9)	73,3
6	1 (3,9)	58
11	0 (0)	96
14	2 (7,7)	64
16	2 (7,7)	64
20	2 (7,7)	60
21	2 (7,7)	58

Results of research show that P-wave onset point was determined in 7,7 ms after reference point in most cases. However, it doesn't exclude that P-wave onset point cannot be at another position. The key factor was second derivative maximum trend presence at some point.

In future studies we plan to increase the amount of analyzed ECS, and to perform research on averaged analyzed sectors.

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УДК 625.768.5

SOLVING THE PROBLEM OF POLLUTION OF SNOW MASSES WITH A MOBILE SNOW MELTING PLANT

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Currently, environmental pollution has acquired the status of being extremely urgent. Pollution has many causes, and one of them is the untimely sweeping and disposal of snow.

Snow pollution occurs in two stages. When snowflakes form, they absorb pollutants from the atmosphere, so the snow that has fallen is already polluted. Then there is even more pollution of the snow that has already fallen, pollutants settle on it from the atmosphere, and also come from the underlying soils and rocks [1]. It can be concluded that snow pollution occurs for the same reasons as atmospheric air pollution.

Thus, a huge amount of dangerous chemicals and compounds gets into the snow. When snow melts, these chemicals enter the soil, the drains and reservoirs, and then into the organisms of plants and animals, including the human body. In the snow taken in the city of Kazan, excess of the maximum permissible concentration for suspended solids, nitrites, phosphates, phenols, fluorides, petroleum products, iron, copper, zinc, aluminum, manganese, mercury, nickel, cobalt was revealed [2].

At the moment in Russia, snow is disposed by three main methods. The first method is grinding the snow on special rollers that retain large debris, and then dump the snow into the sewer system, where it melts due to the heat of the sewage. The second is melting snow on mobile units, and pouring the liquid into sewers or gutters. The third is the storage of snow in snow dumps, where it melts under the influence of natural heat.

The listed ways of snow disposal do not have any methods of cleaning from external pollutants that accumulate in snow masses.

Thus, a patent study of inventions for cleaning snow masses from external pollutants, was conducted.

Most of the found devices have such disadvantages as a long cleaning time, the need for an external additional device for hot water supply, the availability of only physical methods of cleaning, the inability to use the resulting liquid for domestic and household needs.

The mobile snow melting plant described in Patent No. RU 2695676 E01H 5/10[3] is devoid of these disadvantages. The proposed device performs melting and carrying out mechanical and chemical cleaning of snow masses. The plant will help improve the environmental situation. Figure 1 shows a diagram of the mobile snow melting plant.

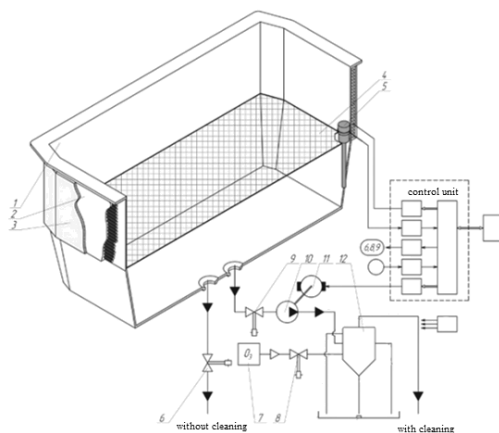


Figure 1. Diagram of a mobile snow melting plant

The principle of operation of the mobile snow melting plant is that the snow is placed in the snow melting box 1 with thermal panel 2, from the heating of which the snow melts. The liquid passes through the grate 4, thus the liquid is cleared of coarse debris. When the maximum liquid level is reached, the liquid level sensor 5 is triggered and the control panel receives information about the need to open the liquid drain valve. Then the user chooses the program "with cleaning" or "without cleaning" by himself. If there is no need to clean the melted snow, the water leaves the

plant through the drain without cleaning (solenoid valve 6). If snow cleaning is necessary, the electric drive 11 of the hydraulic pump 10 is activated, which feeds the contaminated liquid through the solenoid valve 9 into the two-stage hydrocyclone-oxidizer 12. Oxidizer from the oxidizer cylinder 7 enters the hydrocyclone-oxidizer through the solenoid valve 8. After passing through the hydrocyclone-oxidizer, the purified liquid exits the plant through the drain with cleaning, and the pollutant concentrate and its neutralization products go to the sludge box. [4]

Figure 2 shows the exterior view of the mobile snow melting plant.

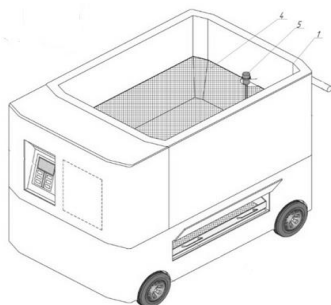


Figure 2. Exterior view of the mobile snow melting plant

Further, the purpose of the work is to create a prototype of a mobile snow melting plant, identify shortcomings and eliminate them. To create a prototype of the plant, it is necessary to develop a control unit.

The first task for creating a control unit is to develop a block diagram. Figure 3 shows the block diagram of the control unit of the mobile snow melting plant.

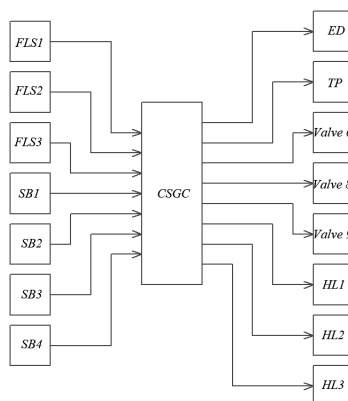


Figure 3. Block diagram of the control unit of the mobile snow melting plant

The main part of the control unit is the control signal generation circuit (CSGC), which includes three triggers. The triggers receive a signal from float level sensors (FLS1-FLS3) and buttons (SB1-SB4). Next, a control signal is generated and fed to the electric drive (ED), thermal panel (TP), solenoid valves (Valves 6, 8, 9) and alarm lamps (HL1-HL3).

The introduction of a mobile snow melting plant will help reduce environmental pollution and reduce the impact of negative factors on the human body. The situation with excess snow in hard-to-reach areas will be improved. Consumers of a mobile snow melting plant can be enterprises and

private owners of small territories (including several facilities at different points), schools, children's institutions, administrative buildings that need to be completely cleaned of snow cover, avoiding its storage; companies offering housing and communal services.

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SIMULATION OF THE INFORMATION-MEASURING CONTROL CHANNEL OF A MOBILE SNOW MELTING PLANT

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Mobile snow melting plant (patent № 2695676) [1] performs melting and carrying out mechanical and chemical cleaning of snow masses. The plant will help improve the environmental situation.

To create a prototype of this mobile snow melting plant, it is necessary to develop a control unit.

The signal comes to the information and measurement control channel of the mobile snow melting plant from the float level sensors and control panel buttons. The information is processed and the control signal is formed. The control signal is applied to the thermopanel, the pump and the solenoid valves. This is how the mobile snow melting plant is controlled.

Therefore, the following tasks are set in this paper:

1. development and description of the electrical circuit diagram of the information-measuring control channel of the mobile snow melting plant;
2. simulation of operation with the use of application software packages.

Development and description of the electrical circuit diagram of the information-measuring control channel of the mobile snow melting plant

Figure 1 shows the electrical circuit diagram of the information and measurement control channel of the mobile snow melting plant.

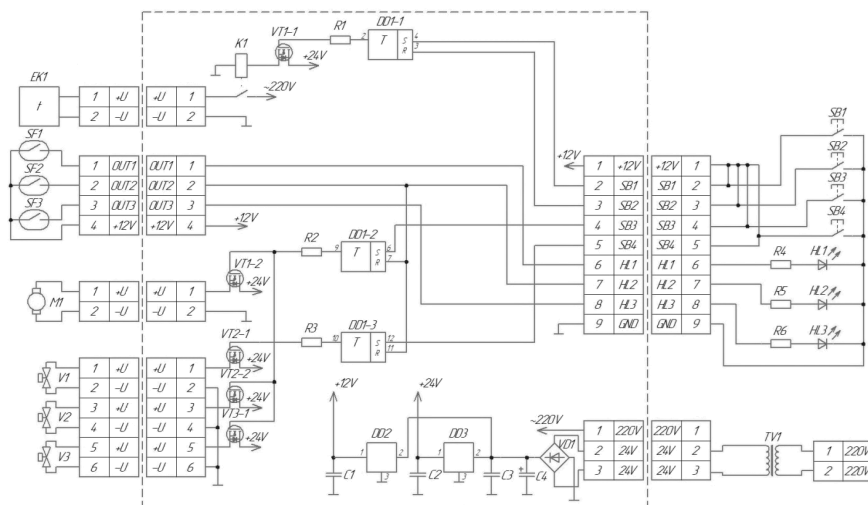


Figure 1. Electrical circuit diagram of the information and measurement control channel of the mobile snow melting plant

The following elements are used in the diagram:

EK1 – a thermal panel is a self-regulating, low-voltage heating cable. The heating cable will be located in the walls of the snow melting box of the mobile snow melting plant. The cable will be covered with a layer of thermal insulation on the outside.

M1 – a pump, which is needed to supply the contaminated liquid for cleaning to the two-stage hydrocyclone-oxidizer.

SF1-SF3 – float level sensors, which are used to signal the liquid level limit in the snow melting box and the sludge box of the mobile snow melting plant.

V1-V3 – solenoid valves that open when voltage is applied.

There are three solenoid valves used in total in the plant:

- valve for draining liquids without cleaning;
- valve required to supply the liquid to the two-stage hydrocyclone-oxidizer;
- valve required to supply the oxidizer to the two-stage hydrocyclone-oxidizer.

VT1-VT3 – mop transistors, which act as a switch. The solenoid valves and the pump are energized via the mop transistors. This is how the operation of these elements is controlled.

K1 – relays.

DD1 – the microchip contains four RS-triggers.

The main information processing device in the information-measuring control channel of the mobile snow melter is the RS-trigger.

Three RS- triggers are required:

- to turn on/off the thermopanel;
- to activate the "with cleaning" program;
- to activate the "without cleaning" program.

The mobile snow melting plant is controlled by the control panel.

The control panel consists of four buttons and three alarm lamps. The buttons SB1-SB4 are designed to turn on/off the thermal panel and select the program "with cleaning" or "without cleaning". The alarm lamps HL1-HL3 are designed to signal the operation of float level sensors, that is, to signal the maximum liquid level in the snow melting box and the sludge box of the mobile snow melting plant.

The power supply unit must generate a stabilized voltage of +24V, +12V at the output, while the input of such a power supply unit is supplied with a mains voltage of 220V with a frequency of 50Hz.

The power supply unit consists of a transformer TV1, a diode bridge VD1 and voltage stabilizers DD2, DD3. Capacitors C1-C4 are needed to smooth out high-frequency pulsations.

Simulation of operation with the use of application software packages

Mathematical modeling of the developed information and measurement control channel of the mobile snow melting plant in the Multisim and Ultiboard programs has been performed.

Figure 2 shows a diagram of the information-measuring control channel of the mobile snow melting installation assembled in the Multisim program. In this scheme we used foreign analogues of the selected elements of the circuit, because in the program Multisim there are no elements of domestic manufacturers.

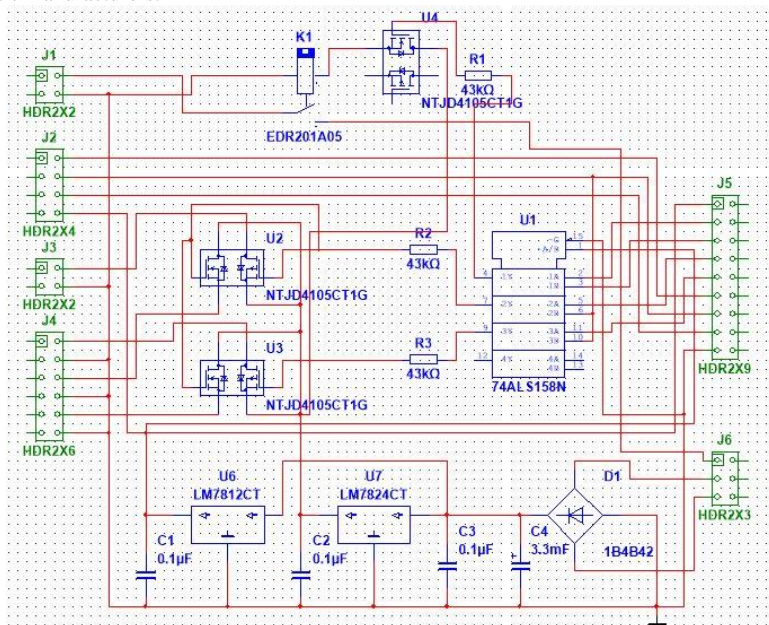


Figure 2. The scheme in the Multisim program

We assembled the circuit in Multisim and transferred it to Ultiboard to create a 3D model of the printed circuit board. Placed the elements on the board and traced the wires.

Ultiboard program has the ability to view the designed board in 3D. Figure 3 shows a 3D view of the printed circuit board.

The resulting printed circuit board of the information-measuring control channel of the mobile snow melting plant has dimensions of 54x47 mm.

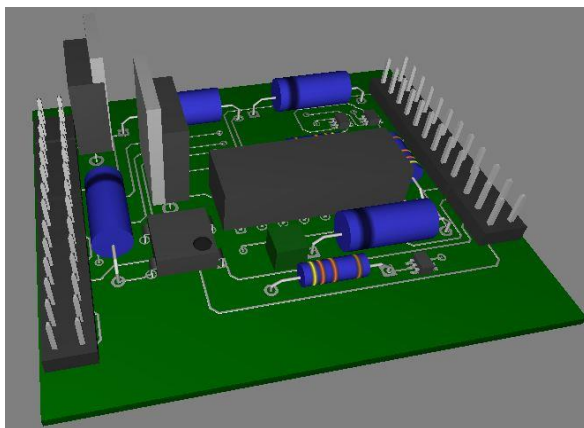


Figure 3. 3D view of the printed circuit board

Thus, this paper presents the developed electrical circuit diagram, as well as the mathematical modeling of the information-measuring control channel of the mobile snow-melting plant in the programs Multisim and Ultiboard.

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УДК 620

ANALYSIS OF THE EFFICIENCY OF VARIOUS METHODS OF ENERGY-SAVING MEASURES IN A RESIDENTIAL BUILDING

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The issue of energy saving has been and remains relevant, since technological progress requires an increasing amount of energy resources; an increase in the population leads to an increase in the load on thermal and electrical power plants; people tend to spend less but get more; non-renewable resources are depleting their reserves; the ecology on Earth is deteriorating. In this regard, the following aspects come to the fore:

1. The need to ensure sustainable rates of economic development.
 2. The need to provide the population of the country and its economic complex with the necessary fuel and energy resources.
 3. The importance of preserving fuel and energy resources for future generations.
 4. The need to ensure environmental safety.
 5. The high cost of ensuring the life-support.
 6. Increasing complexity in extraction and transportation of fuel and energy resources.
- According to previous studies, the potential for energy saving and the implementation of energy saving measures can reduce the consumption of heat energy by (30-50)%, slightly increasing the cost of construction and reconstruction[1].

Due to the growth of cities, as well as the current situation with the coronavirus and the increasingly popular remote work, there is a steady trend of people moving from cities to private

residences. Today, almost 24% of families in Russia live in individual housing. However, it is often remote from central power lines, which either leads to increased transportation costs or the need to install individual systems.

The aim of the work is to substantiate the feasibility of introducing various methods of energy conservation in the private residential sector.

The object of our research is a comparative analysis of various ways to reduce heat leaks and ways of alternative energy production in order to save money and conserve resources. The paper examines the effectiveness of installing thermal insulation of the walls of a residential building with expanded polystyrene and a thermal protective film on windows, a recuperative ventilation system, a heat pump, solar collectors, solar electric panels, and a mini hydro turbine. The criterion for assessing the effectiveness and feasibility of measures is the actual savings.

To achieve this goal, an analysis was made of the efficiency and possible saving of resources and money when using energy-saving, energy-efficient measures and alternative and low-potential energy sources on the example of a residential 2-storey building located in the climatic conditions of Kazan.

The following tasks are performed:

1. Analysis of the effectiveness of the installation of thermal insulation.
2. Analysis of the recuperative ventilation system efficiency.
3. Analysis of the heat pump efficiency.
4. Analysis of solar collectors efficiency.
5. Analysis of the effectiveness of electrical panels.
6. Analysis of a mini hydro turbine efficiency.

Research results have shown that the most cost-effective and energy-efficient measure is to install thermal insulation materials on walls and windows, resulting in significant annual savings.

An analysis of the use of recuperative heat exchangers in the ventilation system in private houses has shown that such systems are more profitable in large public buildings[2].

From the results of studies of the efficiency of HPU, it is clear that a heat pump is more economical than centralized or electric heating, but significantly loses to a gas boiler due to climatic conditions and low cost of gas in Russia[3].

From studies of solar power supply systems, it can be concluded that the installations used today in the climatic conditions of Kazan do not provide significant benefits for private use. However, this issue is worth revisiting in the future if engineers can improve the efficiency of solar power supplies[4].

The use of mini hydrotubes in a residential two-story building is almost useless due to the weak water pressure in the water supply system, therefore, it is advisable to install hydraulic turbines only in high-rise buildings with high flow rates and water pressures[5]

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УДК 621.316.925

THE EFFECT OF SATURATION OF CURRENT TRANSFORMERS ON THE OPERATION OF RELAY PROTECTION DEVICES

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In transient and steady-state short-circuit (SC) modes, protective current transformers (PCT) can be saturated and operate with increased errors, the magnitude of which depends on many factors, in some cases, difficult to consider. The heavy influence on the extent of the error is provided by: the multiplicity of fault currents, the presence of aperiodic components in the primary currents and the time constants of their attenuation, the connection diagrams of the secondary windings of CT and relays, the magnitude and nature of the CT load, etc.

When studying the effect of saturation on the behavior of protection devices, it is worth considering two cases:

- saturation is caused by the presence of aperiodic components in the short-circuit current;
- in the absence of aperiodic components, for example, saturation happens due to exceeding the permissible load.

It should be noted that in three-phase groups of CT compounds, both cases of saturation can be observed simultaneously. CTs of different phases generally work with different errors and have a mutual influence on each other.

If there are aperiodic components in the primary currents, a number of stages can be distinguished in the CT operation. In the initial stage, T is not saturated, and aperiodic components are present at the transformed points, and there are no higher harmonics. The duration of this stage can vary significantly and depends on the specific operating conditions of the CT. To reduce the effect of CT saturation on the protection operation, it is proposed to use special algorithms for restoring the signal distorted by the saturation phenomenon. However, solving this problem requires very complex calculations during the process and a significant increase in the number of samples for the period of the fundamental frequency.

If there are no aperiodic components in the primary short-circuit currents, then only odd harmonics appear in the secondary currents when the CT is saturated, and the error value remains practically unchanged during the entire short-circuit time. With this type of saturation, reducing the secondary load on the CT is a fairly effective measure to reduce errors.

Today, electromechanical relay protection devices of power facilities are being gradually replaced by microprocessor-based ones, which allow for faster shutdown of damage by reducing the selectivity stage to a value of 0.10-0.15 s, higher accuracy of processing input information. The basic operating current error is usually 2-5%, the return coefficient is in the range of 0.95-0.96. The proper response time of the measuring elements is approximately 30-50 ms.

Electromechanical and microprocessor protection devices have different methods of processing input information. Electromechanical relays react to the square of the current value in the relay, which generally contains an aperiodic component, a periodic component of the fundamental frequency and higher harmonics. In microprocessor measuring elements (ME), the condition for triggering is that the integral value of current in the relay exceeds the trip set point.

The behavior of the current cut-off (CCO) of instantaneous action performed on an electromechanical element base can be greatly influenced by aperiodic components in short-circuit currents. The degree of this influence increases with a decrease in the response time of the CT. Under the action of aperiodic components, the area of action of the T increases in comparison with the calculated values, which may cause non-selective protection actions. When the CT is saturated, depending on the nature of their saturation, the zones protected by the current cut-off may be reduced or their duration may increase. Electromechanical currents are also more sensitive to

magnetization current surges when power transformers are switched on or when voltage is restored after external short circuits are switched off. In microprocessor protection devices, the range of the protection is more stable, since the influence of aperiodic components and higher harmonics are eliminated. They also turn out to be less sensitive to magnetization current surges.

Microprocessor devices are highly accurate and have more stable characteristics compared to their electromechanical counterparts. The errors of measuring CT of traditional design can significantly exceed the errors of microprocessor protection devices, which is the reason for reducing the efficiency of their use. Saturation of CT in both steady-state and transient modes of operation can lead to slower damage elimination and non-selective protection actions. Taking into account the saturation of CT connected to a certain three-phase group presents significant difficulties. The most complete account of saturation can be made on the basis of complex mathematical models of the distribution network and protection devices by the method of computational experiment. It is advisable to carry out such an assessment of the behavior of protection devices both at the stage of developing new devices with more advanced algorithms of functioning, and in operating conditions.

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УДК 621.314

DEVELOPMENT OF A MATHEMATICAL MODEL OF A THREE-PHASE PHASE-LOCKED LOOP

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The phase-locked loop (PLL) system is now a key technology in many radios and satellite communication circuits. PLL circuits are used in transmitters and receivers, analog and digital modulation, and digital signal transmission. The PLL allows for fine tuning and filtering without the large filters used in detection circuits [1]. The PLL system is widely used, many books and articles are devoted to it.

Phase locked loop is an automatic control system that adjusts the phase of the controlled oscillator so that it is equal to the phase of the reference signal. The PLL compares the phases of the input and reference signals and outputs an error signal, which is the difference between these phases. The error signal then passes through a low-pass filter and is used as a control signal for the voltage-controlled oscillator [2]. This generator provides negative feedback. If the output frequency deviates from the reference, then the error signal increases, acting on the oscillator to reduce this error.

For the first time, the concept of phase-locked loop (PLL) was proposed in 1923 and was used mainly in the field of radio engineering. Over time, PLL algorithms have become widespread in other areas of industry, such as communication systems, electric drives, and power supplies. A quality PLL can provide fast and accurate synchronization with the network with a high stability margin. There are many ways to implement a PLL, but the most common is to use a phase locked loop, the block diagram of which is shown in Figure 1 [3].

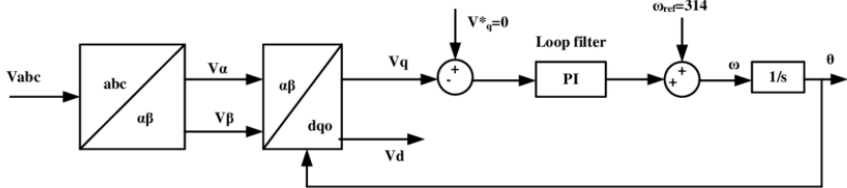


Figure 1 - PLL block diagram

The algorithm sequentially performs the Clarke transformation and the Park transformation, having previously measured the mains voltage. The *PI*-controller provides such an angular velocity of the coordinate system *dq*, at which the generalized vector of the measured quantity will be codirectional with the *d* axis. Accordingly, the *q*-component of the measured value will be equal to zero. To ensure this, a voltage error signal U_q must be applied to the input of the regulator. Obviously, the reference voltage vector along the *q*-axis will be zero. Below is a model of a phase locked loop for a three-phase signal. For ease of investigation, the three-phase voltage system is symmetrical and does not contain higher harmonic components.

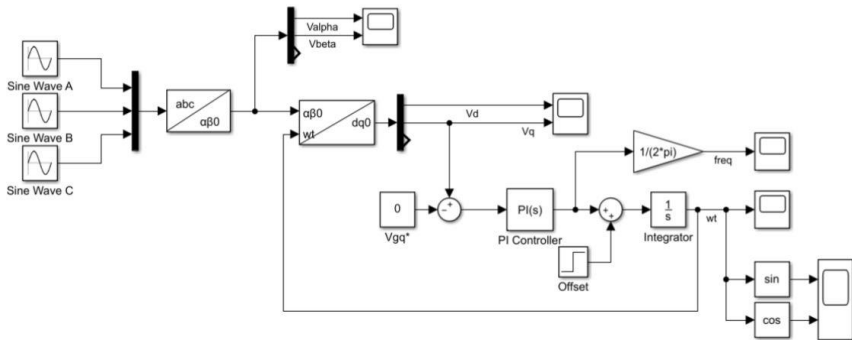


Figure 2 - PLL model for three-phase voltage inverter

During operation, the system rotates the *dq*-system in such a way until the U_q value becomes zero. It is worth noting that an offset is added to the PI controller output, which increases the quality of the transient at the beginning, reducing the time it takes for the output to reach the steady state value. This is convenient when the value of the measured PLL frequency is not a random variable, but a value that changes in a known range. During the simulation, the Offset value was assumed to be zero [4]. The figure 4 shows the graphs of voltage changes along the *d* and *q* axes.

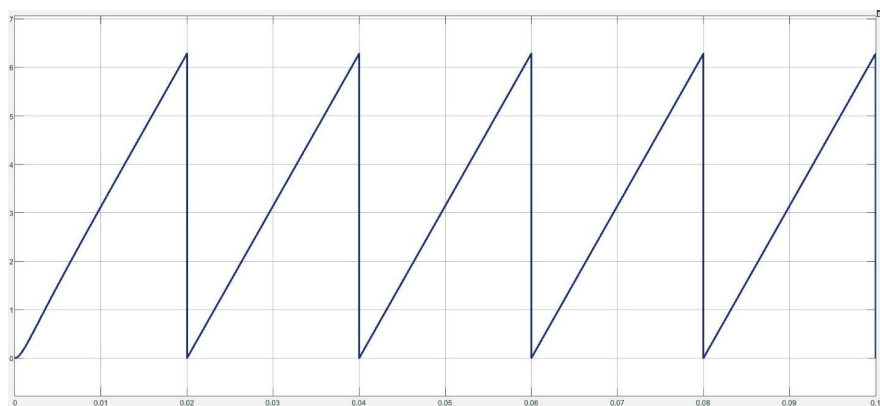
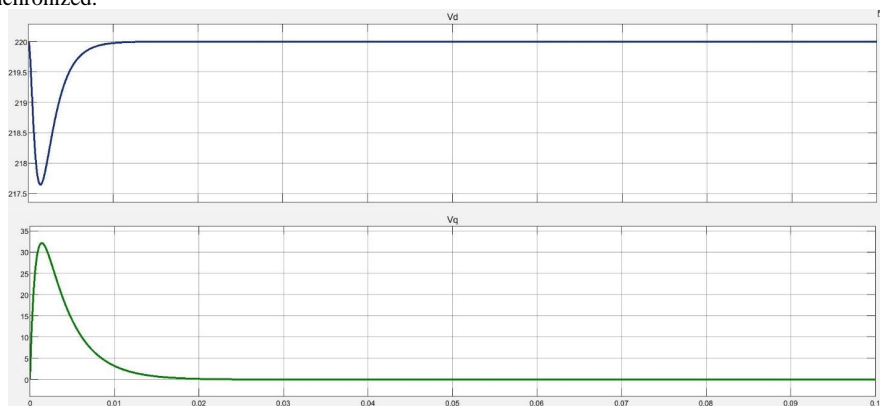


Figure 3 - Output voltage angle graph

Figure 3 shows the variation in the angle of the space vector over time. At the initial moment, a transient process is observed. Further, the process proceeds linearly, which indicates that the PLL is synchronized.

Figure 4 - D and Q voltage components

Thus, in the course of the work, the mathematical model of the phase-locked loop was checked. It was found that the time to reach steady-state values, dq -voltage components, is less than one period of the mains voltage change. In the study of the transient process of changing the voltage frequency, it was found that the overshoot is no more than 10%.

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FEATURES OF THE USE OF INDOOR POSITIONING SYSTEMS FOR VARIOUS CUSTOM SOLUTIONS

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Currently, there is a growing demand for positioning systems for various indoor objects. This is due to the fact that most traditional satellite navigation systems cannot be used due to the shielding of radio wave propagation by building structures. At the same time, the ability to quickly receive information about the location of objects is a prerequisite for the effective development of complex solutions based on the Internet of Things and cyber-physical systems.

An overview and classification of the most relevant indoor positioning technologies is presented. They are evaluated according to their purpose, cost, accuracy, productivity and complexity of implementation on their basis of dispatching and information systems. The analysis of consumer requirements for dispatch systems, which impose restrictions on the architecture and the choice of basic technologies, is carried out. Hybrid approaches to integrating various technologies are considered to overcome specific limitations inherent in specific implementations.

Three categories of radio engineering positioning systems are considered in most detail: UWB [1], RFID [2] and systems based on traditional wireless communication standards BLE [3], Wi-Fi, IEEE 802.15.4, etc. Particular attention is paid to the architecture of applied solutions based on positioning technologies, the possibility of using smartphones, and the existing wireless infrastructure [4, 5].

Examples of practical implementation of dispatching and information systems for medical and educational institutions, museums, industrial enterprises, shopping centers are given. The complexity of implementation and the cost of equipment for various basic technologies are estimated.

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INSTALLATION OF A FILTER ELEMENT IN A SEPARATOR AS A WAY OF THE HIGHEST QUALITY NATURAL GAS PURIFICATION

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Natural gas (NG) is one of the most common energy sources. Its consumption in the world is constantly increasing. Due to technical, economic and geopolitical problems, nowadays more and more attention is paid to the transportation of GHG in a liquefied state. This is primarily due to the fact that liquefied natural gas has a higher volumetric energy capacity compared to the gaseous product.

The feed gas supplied to the liquefaction complex from the field or from the main gas pipeline contains light hydrocarbons, moisture, various impurities such as aluminum oxides, compounds of silicon, iron, calcium, magnesium, sulfur, hydrogen sulfide, carbon dioxide, and so on. Their presence in SG reduces the use value of gaseous fuel and can lead to a violation of the conditions for the functioning of power equipment up to failure. Thus, the problem of removing moisture, mechanical impurities and condensate from the composition of the steam generator is urgent.

One of the main problems associated with the process of natural gas purification from various impurities is the removal of very small particles, 5 microns in size.

The aim of the work is to develop an improved method for the separation process.

As a cleaning device, let's consider a vortex separator located at the inlet of the natural gas liquefaction plant immediately after the throttle.

Based on the results of calculations presented in the work on modeling the dynamics of a two-phase flow in a separator [1], the quality of separation of particles was determined depending on their diameter in the specified range.

Under the action of centrifugal forces, microparticles drift to the outer boundary of the computational domain, which leads to an increase in their concentration near this boundary.

At the same time, under the action of interfacial friction forces, particles are captured by turbulent vortices, which, according to Fick's law for turbulent diffusion, leads to particle migration from the outer boundary.

The competition between these two processes depends mainly on particle size and becomes a determining factor for the quality of separation of particles from the stream.

The graph (Fig. 1.1) shows the evolution of separation quality over time for particle diameters in the range from 2 μm to 20 μm .

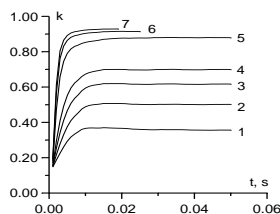


Figure 1.1 - Evolution of separation quality over time for particle diameters in the range from 2 μm to 20 μm (1 - 2 μm , 2 - 3 μm , 3 - 4 μm , 4 - 5 μm , 5 - 10 μm , 6 - 15 μm , 7 - 20 μm)

All curves reach a stationary level, which indicates the establishment of a stationary flow structure in this section. The time for establishing a stationary mode for a given particle size is (0.01-0.02) s ((2-3) revolutions). For particle diameters $d < 10 \mu\text{m}$, the separation quality does not exceed 88%. In many technical devices, this value does not meet the requirements.

One of the solutions to the problem associated with the removal of very small particles from natural gas, up to 5 microns in size, is the installation of a filter element, which is a supporting structure made of porous metal with high gas permeability. This filter element can have a conical, cylindrical or other shape. To solve this problem, consider a separator capable of removing very fine particles from natural gas, up to 5 microns in size.

The design diagram of the separator is shown in Fig. 1.2.

Natural gas purification device operates as follows. Natural gas containing various kinds of dispersed inclusions (solid and liquid) is fed tangentially through the gas supply pipe 2 into the annular cavity of the outer channel 18, as a result of which it swirls. In a swirling flow, due to the action of mass forces, dispersed inclusions, which have a higher density compared to the density of the gas, drift to the inner wall of the housing 1 and are concentrated in the near-wall layer. The inclusions concentrated in the near-wall layer move further along the inner surface of the profiled bottom 6, unfold and through the slotted channel 21 fall into the cavity 22 of the collector 7. The turn of the flow by the surface of the bottom 6 increases the concentration of particles in the near-wall layer. Particles ranging in size from 10 to 5 microns are concentrated in the wall (boundary) layer with a thickness of more than 3 mm, and particles less than 5 microns in size are separated unsatisfactorily.

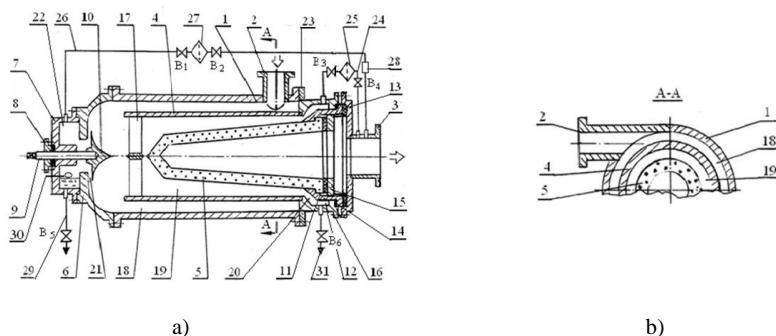


Figure 1.2 - Structural diagram of the device for cleaning the transported gas
(a - front view; b - side view)

From the inner channel 19, the gas stream containing smaller particles that did not enter the cavity 12 is retained by the filter element 5, which ensures the final purification of the gas. The cleaned gas is directed through the cleaned gas outlet 3 to the consumer.

The filter element 5 can have a conical or other shape and is a supporting structure made of porous metal (aluminum, nickel, copper, etc.) with high gas permeability, which ensures its low hydraulic resistance. The pore sizes of the filter element 5 determine the limiting size of dispersed inclusions in the gas flow supplied to the consumer.

Thus, a separator capable of removing very fine particles of up to 5 microns from natural gas has been designed and an application has been filed. As a result, after the examination of the application for an invention on the merits, it was decided to grant a patent for the invention [2].

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УДК 620.179.1

BIONIC DESIGN TECHNOLOGY OF BIKE CONSTRUCTION ELEMENTS WITH THE ADDITIVE MANUFACTURING ADVANTAGES

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Abstract: This paper shows the benefits of additive manufacturing of bicycle structural elements using generative design, compared to traditional manufacturing methods for these parts.

Keywords: Bionic design, bike construction elements, additive manufacturing, 3D printing techniques, 3D model optimization.

The bicycle pedal is a part of the transmission that attaches to the cranks and transfers the rotational forces of the cyclist's legs through the transmission and chain to the rear wheel.

There are many different models of bike pedals, differing from each other in the materials used, colors, designs and, most importantly, price. Moreover, the cheapest models are not always the worst. Often, a simple and cheap model serves almost the entire cycling life, and complex and expensive designs change over several seasons.

In this paper, a pedal of the "treadmill" design with a rather primitive design was considered. Typically these pedals are made of plastic, for example, traditional bicycle pedal manufacturing methods (molding) use reinforced nylon.

Removal of the steering wheel - a structural detail of the steering unit, providing a reliable connection of the steering wheel with the steering wheel rod. It is also called a steering bracket; is an elongated piece with attachments on both sides: to the handlebar and to the handlebar shaft.

The stem defines the distance the handlebars are from the rider's body. The longer it is, the further the cyclist will be from the handlebars, and vice versa. Also, with the help of the stem, it is possible to adjust the angle of inclination of the steering wheel.

Stems are made from the same materials as bicycle frames - steel or aluminum alloys, titanium or carbon. According to the manufacturing method, there are forged, welded, milled and mixed brackets.

The stem of the FSA SL-K was taken as a basis for a handlebar with a diameter of 25.4 mm; length 100 mm. It is made by welding parts from steel 30XMA (analogue of Steel 4130). After creating 3D models of parts in the Compass 3D software, they are imported into Autodesk Fusion 360 (a comprehensive package for industrial design and engineering).

Then, in the Design section, the geometry is added, in the Simulation section, loads and constraints are set. Target loads are approved for the area of attachment of the handlebars (1500 N each along the -z and y-axes) and for a bicycle pedal (1800 N along the -z). The initial material is selected (Steel 30XMA - for the stem, reinforced nylon - for the pedal).

As a result, we get a picture of the distribution of loads, areas of greatest stress and deformations.

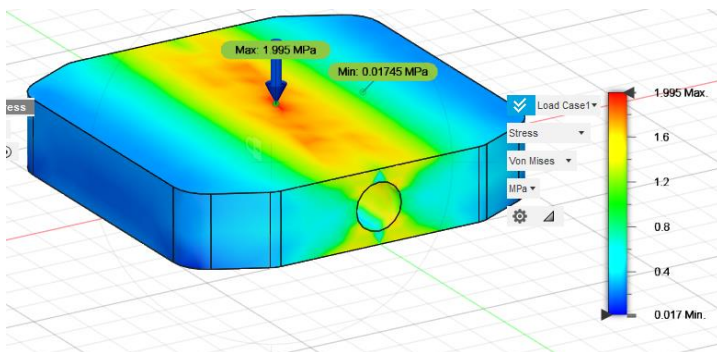


Fig. 1. Distribution of loads on an unoptimized part

From the resulting picture, we can conclude that the parts have an unreasonably large margin of safety. The maximum stresses experienced by the part are 2 MPa, which is many times less than the critical values for a given material.

For the manufacture of the stem by the additive manufacturing method, two materials were selected - Inconel 625 (nickel-chromium alloy with the addition of niobium and molybdenum additives) as one of the most studied and available materials on the market and Aluminum AlSi10Mg (silicon-alloyed aluminum alloy). These materials are produced according to ASTM standards: forgings, fittings, welded pipes, flanges, valves and other products.

ABS plastic was chosen for the production of the bike pedal. The main characteristic of this plastic is its high mechanical strength and impact resistance. ABS products are durable enough that it is often used for printing functional objects with practical applications. Even under high mechanical stress, the ABS plastic product deforms, but does not crack or collapse. At the same time, this plastic has sufficient elasticity and low weight. High wear resistance, high and low temperature resistance. ABS can withstand even short-term heating up to + 100C, and its long-term use is possible at temperatures up to + 80C. In addition, this material has a relatively low price, which has a positive effect on the economic component of the project.

Optimization was also done in Autodesk Fusion 360 with the Generative Design plug-in. In the simulated bike pedal and stem models, the "Starting Shape" areas were selected - the initial (full) shape of the part, from which the program will begin to optimize; "Preserve Geometry" - the part of the model that the software algorithm will have to leave unchanged; "Obstacle Geometry" - geometry (possibly additional) that limits the work space of the algorithm.

The next step is to set the objective function of the algorithm. The choice is given to a decrease in mass and an increase in stiffness. In my case, the goal is to reduce the mass of the part as much as possible with maximum loads within the critical limits.

Therefore, I select the function of reducing the mass with Safety Factor = 2. Next, the load on the part is set, similar to those set in the simulation of static loads, and the place of fixation (support). The load is applied to the surface that is part of the Preserve Geometry.

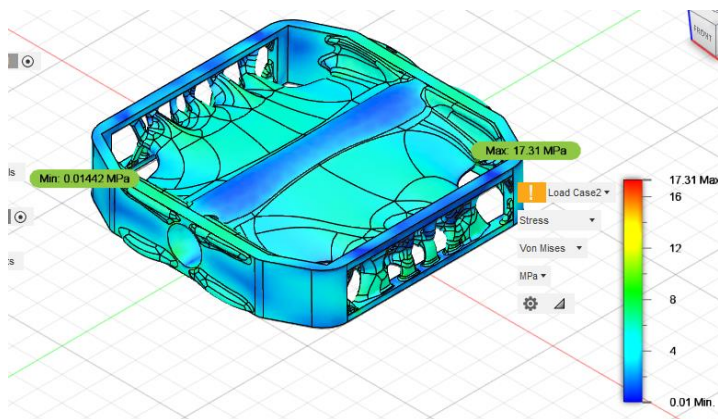


Fig. 2. Distribution of loads on the optimized bike pedal

The result of the work of the algorithm was a part with a rather complex shape, but available for additive manufacturing, but at the same time with a much lower weight - 89.5 grams, while the initial weight was 188.9 grams. The maximum loads on the part during the re-simulation were 17.31 MPa, which is significantly less than the critical ones for ABS plastic

As a result of the Generative Design optimization module, three optimization results were obtained. For comparison with the original material of the part (Steel 30XMA), we take two samples from Inconel 625 and one from AlSi10Mg. Below are their main characteristics in comparison with the original geometries and materials.

Table 6. Comparison of the parameters of the original part and the results obtained after the generative design

	Steel 30XMA	Inconel 625(1)	Inconel 625(2)	AlSi10 Mg
Mass, kg	0,443	0,264	0,273	0,102
Maximum deformations, mm	0,04	0,25	0,24	0,2
Maximum strains, MPa	58	392	455	219
Margin of safety	13,34	1,64	1,41	1,10

Based on the calculation results presented in the table, it can be seen that the initially selected material Steel 30XMA is the worst among those presented due to the large mass of the model (the bracket is made with an unnecessarily high margin of safety, which, together with the high mass, makes it impractical to use it in the bicycle design), the model from Inconel 625 (2) shows the maximum stresses, the model from AlSi10Mg has the smallest safety factor under load. Thus, the model from Inconel 625 (first design variant) performed the best. In what follows, it is for it that the parameters and calculations are given.

A route technology for the manufacture of bicycle structural elements was compiled, a generative design of the selected parts was made in specialized software.

The results obtained show the possibility of using additive technologies for the production of these parts, reveals their advantages, due to which the replacement of traditional production methods becomes expedient.

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УДК 621.31

EV FAST CHARGING STATION CONTROLLER LAYOUT*A.I. Mavrin*

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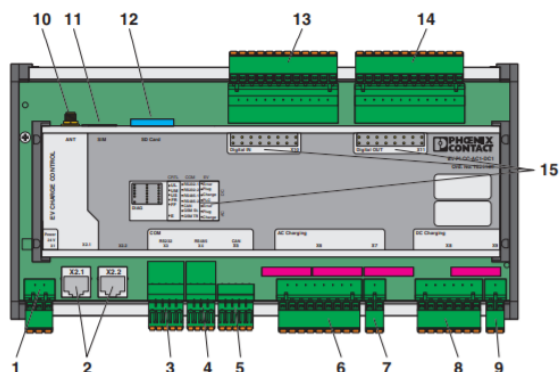
EV fast charging station controller is an essential element of the station. It interacts with an electric vehicle (EV) controller via 7 communication channels in the CHAdeMO charging connector. The controller receives information about output voltage, currency, and insulation state from a vehicle controller. It also processes information from current and insulation sensors, providing real-time monitoring of the system. The controller displays information about the charging process state on the monitor in real time. An RFID card reader may be used to identify a driver.

CHAdeMO connector is the most common fast-charge connector in Russia. Current charging protocols are capable to provide up to 400 kW of electric power. Table 1 describes the CHAdeMO charging connector pin assignment, as well as the diameter of the wires. [1]

Table 1 – CHAdeMO charging connector pin assignment

Pin number	Pin assignment	Diameter, mm
1	Reference ground for insulation monitoring	1.6
2	Electric vehicle control relay (1)	1.6
3	Not installed	–
4	“Ready to charge” signaling	1.6
5	Power supply line (-)	9
6	Power supply line (+)	9
7	Connection detection signal	1.6
8	Noninverted communication channel via CAN bus protocol	1.6
9	Inverted communication channel via CAN bus protocol	1.6
10	Electric vehicle control relay (2)	1.6

It is necessary to use a controller that enables the operation of the CAN bus protocol, as well as the connection of CHAdeMO connector pins, charging station, sensors, and communication channels with the rectifier module controller and other equipment. As an example, it is suggested to use the EV-PLCC-AC1-DC1 controller, specially designed for EV fast charging stations. Nevertheless, the fundamental implementation of the controller connections will remain unchanged for other controllers. The pin assignment of the relevant controller is shown in Figure 1. [2]



The controller consists of the following components:

1. X1: plug for 24 V supply voltage
2. X2.1/X2.2: Ethernet interfaces (RJ45)
3. X3: RS-232 interfaces
4. X4: RS-485 interfaces
5. X5: CAN bus interface
6. X6: plug for AC charging
7. X7: plug for relay output, charging contactor (AC charging)
8. X8: plug for DC charging
9. X9: plug for relay output, charging enabled (DC charging)
10. Antenna socket
11. SIM card holder
12. SD card holder
13. X10: plug for digital inputs
14. X11: plug for digital outputs
15. Diagnostic and status indicators

Figure1 –EV-PLCC-AC1-DC1 controller pin assignment.

In order to provide a secure connection, it is necessary to set two PLC-RPT-24DC/21 relays to pins 1 and 10, one PLC-OPT-12DC/300DC/1 relay to pin 4, an input resistor with a resistance of 1 kOhm to pin 4, an input resistor with a resistance of 220 Ohm to pin 7. The resulting controller connection scheme is shown in Figure 2.

EV fast charging station controller will implement the necessary charging protocol while ensuring the required safety measures and thresholds for power, current and voltage.

Thus, the scheme is proposed for the implementation of charging station controller and an electric vehicle connectivity by means of the CHAdeMO charging connector as in the case of the EV-PLCC-AC1-DC1 controller. An important characteristic of this scheme is its versatility and applicability for other charging station controllers. The use of this connection layout will allow designing EV fast charging stations which are necessary for charging infrastructure development in our country.

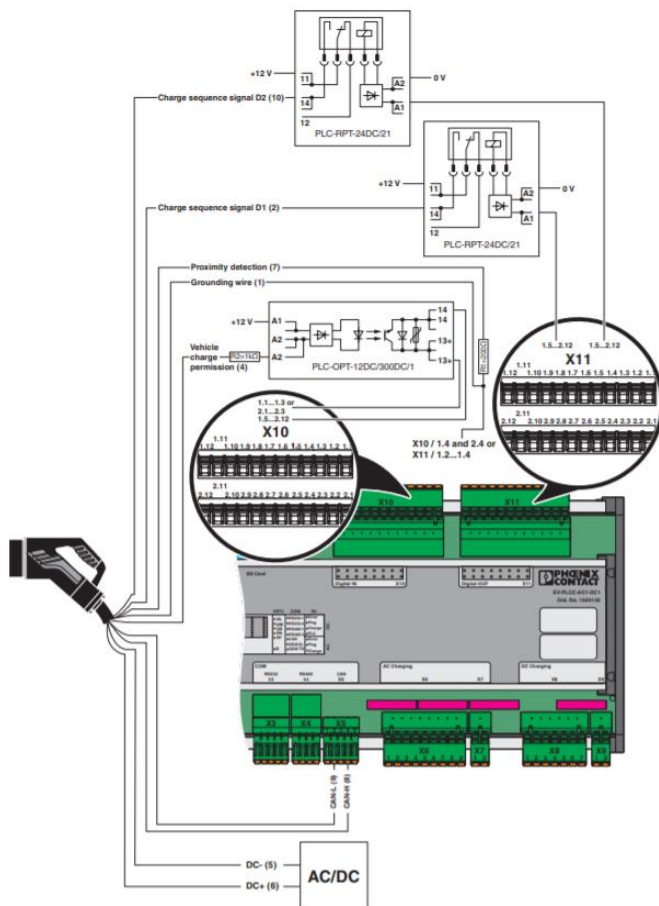


Figure 2 –EV-PLCC-AC1-DC1 controller connection scheme.

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УДК 621.31

EV FAST CHARGING STATION IMPLEMENTATION SCHEME

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One of the most promising areas in transport industry is the development of electric vehicles (EV). Nowadays "traditional" vehicles with internal combustion engines are quite energy-consuming. Electric vehicles have a number of advantages over traditional transport.

An electric car engine is considered more reliable than an internal combustion engine for the following reasons:

1. Higher reliability of the propulsion system due to the use of fewer moving parts subject to wear and less heat generation.
2. High manufacturability enabling effective integration of technical innovations into electric vehicles.
3. Higher energy efficiency.

The European Commission has worked out a roadmap for the development of the automotive industry, according to which the share of electricity used as fuel will increase by 15% by 2030, and far-forth up to 2050, as shown in Figure 1. The planned growth in demand for cars using biofuels, hydrogen, and e-liquids should be also noted. [1]

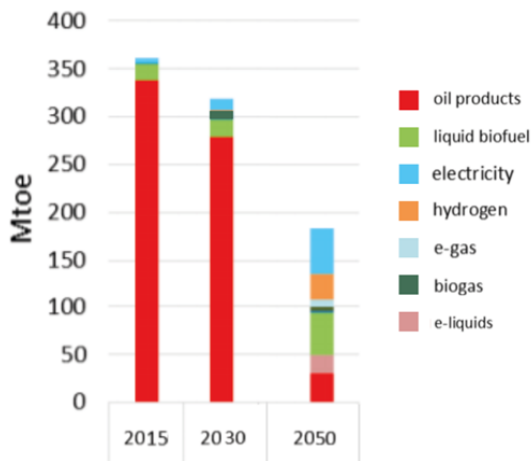


Figure 1 - The European Commission's forecast results for the use of fuels.

An important stage of the electric vehicle market development is the formation of charging infrastructure. Nowadays there are several key parameters for ensuring the process of EV fast charging: direct current up to 125 A, voltage from 230 to 500 V, power from 20 kW. [2]

A scheme for the implementation of a fast-charging station to ensure a stable fast-charging process is shown in Figure 2.

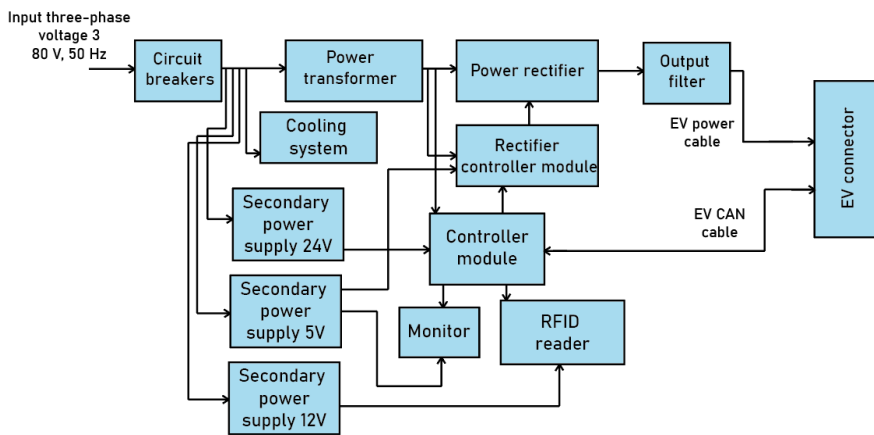


Figure 2 - Fast charging station layout.

The key point of this scheme is a rectifier built on the basis of a thyristor module controlled by a thyristor driver. The choice of this rectification method is justified by the high efficiency of a high-power thyristor rectifier, low rectified voltage ripple and the simplicity of implementation for thyristor control circuit. An important characteristic of a thyristor converter is its low cost. It is possible to realize the concept of a two-way use of electric vehicles and power grid (V2G) due to this scheme. This concept implies the ability to supply electricity from a vehicle to the grid to manage the electricity demand. [3]

Circuit breakers provide disconnection of the charging station in the event of abnormal operating modes. The charging station is protected against short-circuit and overload currents. Protective devices are installed upstream of the rectifier, on the high and low voltage side of the transformer.

Secondary voltage source provides required voltage ratings to power components of a charging station. It converts the AC mains voltage with a nominal value of 220 V into a DC voltage with a nominal value of 24 V. It powers a master controller, two relays, an insulation monitoring device, and a current sensor. The circuit also requires secondary power supply with a nominal voltage of 12 V. It is used to power the relays which connect the controller to a connector in an electric vehicle, as well as the RFID card reader. The scheme also requires a 5 V power supply. It provides power to a control driver, and a monitor. A modular low power converter is used as both secondary power supplies.

Cooling system provides additional cooling for a rectifier and transformer. It allows providing the required temperature for thyristor rectifier operation and realizing air circulation. An active ventilation system significantly reduces the risk of thyristor module failure, since this element is more vulnerable to temperature difference.

Power transformer is used to convert electrical energy to the required ratings for subsequent return to the rectifier. The primary winding of the transformer is connected to the power grid, a rectifier is connected to the secondary winding of the transformer, which generates a constant voltage of 400 V and a current of 125A.

Rectifier is one of the most important components of a charging station. It is necessary to calculate the constituent elements of the rectifier for module choosing. In current charging stations, the rectifier module consists of a thyristor module and damping R-C chain required for overvoltage protection.

Rectifier control unit is a thyristor driver that provides phase control for the rectifier. It controls thyristors, as well as current sensors are connected to it, allowing constant monitoring of the system

state. In the event of a malfunction, the driver gives a signal about the necessity of charging process interruption.

LC output smoothing filter provides the voltage filtration for the subsequent output to the EV connector. This filter helps to decrease the level of ripple in rectified voltage.

Controller module ensures the interaction of the charging station with a person and an electric vehicle. It interacts with the EV controller through 7 communication channels used in the CHAdeMO charging connector. Controller receives information of the output voltage, current intensity and insulation state from the vehicle controller. Controller also processes information from current sensors and insulation status, providing real-time system monitoring.

Thus, the implementation scheme for the EV fast charging station is proposed in this work. Such charging station provides the necessary parameters for a fast-charging station with a capacity of up to 50 kW. It will be possible to develop the charging infrastructure in Russia through the use of this type of fast charging stations.

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УДК 732.881

USING LMS MOODLE IN FOREIGN LANGUAGES TEACHING

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Currently, our society is going through a period of changes, which includes the education sphere as well. The traditional form of teaching, the methods and means used in it, are less and less conducive to the effective assimilation of an increasing amount of information. In this regard, the need for the use of information and communication technologies is increasing. Also, in a post-pandemic, most educational institutions are switching to a blended form of education, where information and communication technologies (ICT) are becoming the main instrument of the learning process. However, there is a certain contradiction between the need to introduce a blended form of education and the insufficient degree of development of methods and technologies for introducing this form into the educational process.

Let us consider the concept of blended learning. K. Bonk and C. Graham, authors of *Blended Learning Handbook: Global Perspectives*, believe that "blended learning includes a combination of different learning methods and methods, as well as a combination of learning forms: learning through personal communication and learning in online ". [5, c.624]

This definition was later supplemented by N. Friersen, according to his theory "blended learning implies a combination of generally accepted forms of classroom learning, requiring the physical co-presence of the teacher and students, with a wide range of learning opportunities through the Internet and digital technologies". [2, c.10]

In the textbook of American B. Tomlinson and Cl. Whittaker [4, p. 258] "Blended Learning in English Language Teaching: Course Design and Implementation", the authors give a classification of blended learning: learning with minimal use of the Internet, blended learning or blended (up to

45% of online activities), hybrid learning, hybrid (45 - 80% of online activities), finally, distance learning, fully online (more than 80% of the total amount of time students are online).

Various digital educational resources and online services can be used to implement blended learning. Among them are learning management systems, cloud storage (Yandex. Cloud, Google Drive), digital libraries, communication tools - e-mail, instant messengers, virtual learning environments, etc.

A large number of advantages, in our opinion, are possessed by learning management systems from English. LMS - learning management system. Among their capabilities are development, management, publication, provision of access to electronic educational resources" [4, p.128-134]. In the modern world, various learning management systems have been created. Thanks to this, educational institutions can effectively implement distance education via the Internet.

The basic principles of LMS are in the abbreviation itself. Learning - training. LMS allows you to create a single repository of e-courses and educational materials (textbooks, presentations, guidelines, etc.). The LMS system implies the management of courses, as well as course participants, learners. It is not just a file repository, but a well-organized system where the course creator can lead the process. System stands for electronic system. The course is possible regardless of the location of the student. The system allows you to design and place courses, the student has access to them. Moreover, LMS automates the routine work of checking test items, reporting and collecting statistics.

One of the most popular learning management systems is LMS Moodle. Moodle stands for Modular Object-Oriented Dynamic Learning Environment - modular object-oriented dynamic learning environment. This system was developed by the Australian specialist in the field of computer science and education Martin Dougiamas in PHP.

Thanks to the use of LMS Moodle, the distance learning process becomes more diverse, since the system includes different ways of presenting educational material, and testing knowledge, and monitoring the success of mastering the program. Modules are the components of the virtual educational environment Moodle. As part of the course, the teacher, transforming the course modules, can build the learning process so that the achievement of the goals and objectives of each lesson is most effective. Let's consider the components of the courses, modules, in more detail.

Among the elements of the course are "Lecture", "Test", "Page", "Forum", "File", "Chat", "Glossary", "Task", "Questionnaire". Among the resources are "Hyperlink", "Book", "Folder", "Explanation", "Page", "File", "IMS Content Package".

LMS Moodle is based on the principles of social constructivism. They are factored into the design of the course and open the environment, create opportunities for collaboration, and facilitate self-study.

"We are all potential teachers as well as students - in a collaborative environment, we are both." Many of the activities in Moodle are designed to allow learners to control shared, shared content through course elements such as forums, wikis, glossaries, databases, messaging, and more. encourages students to share their course experiences with others.

"We learn especially well by creating or expressing something for others." There are many ways in Moodle that people can create, display and share their knowledge:

- Forums are a place for discussion and exchange of multimedia materials and documents (attachments, hyperlinks).
- Wiki is a tool for group work and discussion.
- Glossaries are collaborative "encyclopedias" that can then appear throughout the course.
- Databases allow members to upload any type of media.

"We learn a lot just by observing the activities of our peers." Participants page, online users block, recent activity block - these are the main places where you can see the activity of all course participants.

"By understanding the context of others, we can learn in a more transformative way (constructivism)." There are many different ways to learn more about participants:

- User profile includes fields where members can provide information about their experience.

- Blogs allow people to express their thoughts in public.
- Activity reports show the participant's contribution to the course.
- Log reports show detailed logs of every action taken by a Moodle contributor.
- The survey modules provide many survey tools.

"The learning environment must be flexible and adaptable so that it can respond quickly to the needs of the participants." In LMS Moodle, you can create flexible and highly adaptable courses in different ways:

- The course page itself allows teachers to structure and restructure activities as needed.
- Changes in appearance and functionality will allow teachers to customize Moodle in different ways.
- External systems can be integrated into Moodle to support authentication, registration, etc.

Among the main disadvantages of LMS Moodle are the lack of a built-in course editor, the inability to conduct webinars and video conferencing without third-party programs, as well as the availability of advanced functionality when using plugins, which complicates the use of the system and makes management more costly. Implementing plugins usually requires professional help and time.

Thus, we can conclude that the use of learning management systems has become an integral part of the educational process, in particular, they are effective in a blended learning environment. Free distribution code of the program is of great importance, which allows more users to work in the program. LMS Moodle can be considered the most effective learning management system, since, due to its functionality, it allows you to create courses that include different material, verification tools, collaboration, that is, it meets most of the requirements for this kind of learning tools and platforms.

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УДК 608.2

ORGANIZING A DATABASE IN «NX SIEMENS»

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Siemens NX is a flexible and powerful integrated solution that allows you to quickly and efficiently bring new products to the market. Set of applications included in NX CAD package allows you to solve the problems of developing a complete electronic layout of the entire product and its components for subsequent use in the process of production planning. The formation of the database is an essential step for structuring aggregate data that is jointly stored and processed in

accordance with certain rules. NX is used during the development stages, it greatly facilitates the work.

NX Manufacturing System

NX is the best automated system for information technology design and preparation of computer-aided manufacturing. Also, this program is aimed to solve a wide range of tasks, such as calculation, analysis and simulation of physical processes in the field of engineering. This project is a product of Siemens PLM Software. Basis of the program is Geometric Modeling Kernel. This system is significantly better than the usual CAD systems in field of industrial design. NX's goal is to automate the design and manufacturing of final product. NX makes it possible to implement a complete description of the product development in an electronic model and use this description in all stages of development process.

Implementation of the concept of an adaptive interface

Interface in the NX system is very simple and convenient, it can adapt to any user for different profile of tasks. There is a function called «Role» the main purpose of which is to remember the set of displayed items and menu bars, as well as their position and composition on the screen. The system interface can be represented as a standard Windows architecture with floating toolbars. These toolbars are arranged in different groups depending on their functionality. A number of panels are only present in certain applications. For more flexible work in NX, you can manipulate almost any panel by moving them around the work area or by attaching them to the edges of the graphics area. This greatly simplifies the user's work and allows him to think about the task, and not about the parts of the system interface that are unnecessary at the moment. Also, for those users who are new to NX functionality there is an interactive command search system.

Automation of design development

The main goal of industrial design tools in NX is to create physical appearance (or interior) of the designed product, as well as analysis of its aesthetic and visual external characteristics. Such functionality can automate process of design development like digitizing or creating two-dimensional sketches, or the analysis of various technological processes for creating surface elements and designing the suitable equipment. Huge set of already built-in and plug-in translators can allow two-way data exchange with other CAD systems, and with different levels of data transfer.

Organizing database in the «NX Siemens» system

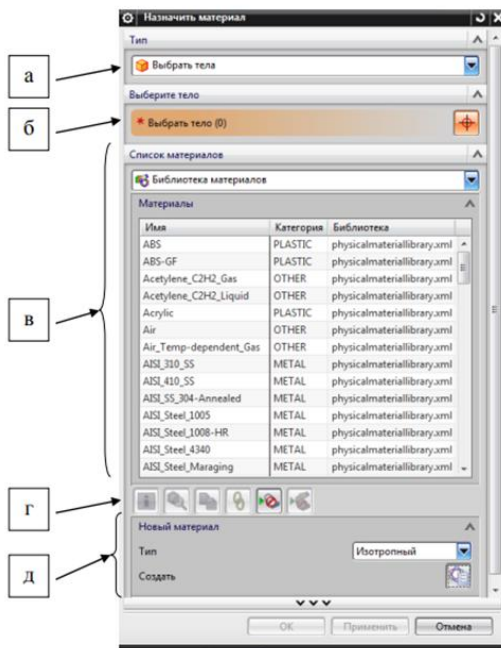
In today's modern CAD systems like NX there are such materials databases that correspond to foreign standards. For systems such as NX, the absence of materials of Russian standards in the usual set is normal. The acquisition of electronic databases of Russian materials for CAD requires extra payment. Application of material databases is carried out at the stages of development and analysis of sheet stamping processes, as well as design and verification of stamping equipment. Products that are obtained as a result of sheet stamping are distinguished not only by their various shapes, but also by a wide range of materials from which they are created. In NX, a material database is an XML file that contains information about the properties of various materials, for example: strength, mechanical, thermal, etc. and their units.

Working algorithm with standard databases of materials in NX

1. Open NX 9.0 software.
2. Create a new model or open already created model.
3. "Assign Material" dialog box opens to assign a material ("Menu" → "Tools" → "Materials" → "Assign Materials")
4. Then an object for which we assign a specific material is selected.
5. Find material from the NX standard material library
6. By clicking on the icon, you can find out the properties of the material

7. Click "Apply".

8. As a result, material for the mathematical model of the part is set.



Picture 1

Loading additional local or user's libraries

1. Menu opens and the "Assign Material (Advanced)" option is selected

2. Checkbox "Local MatML Library" or "User MatML Library"

3. "Browse" option is called, material library file is selected on the computer, and "OK" is pressed.

4. Additional material library is loaded.

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УДК 621.317:615.471

STUDYING THE TECHNOLOGY OF MULTICHANNEL TELECOMMUNICATION SYSTEMS ON THE EXAMPLE OF EQUIPMENT OF CABLE TV BROADCASTING SYSTEMS

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Multichannel telecommunication systems are the backbone of the primary communications network in Russia. The main principle of building multichannel telecommunication systems for many decades has been frequency division of channels. At the end of the last century, multichannel systems ceased to be analog, therefore, equipment for the formation of a group signal in the low-frequency region on the principle of frequency division of channels was no longer produced. The study of the technology of analog multichannel systems with frequency division of channels remained only at a theoretical level, although in our opinion it deserves a more thorough practical development.

The possibility of such a practical study is available, as it seems to us, on the example of the cable television systems widespread up to the present time. The cable television broadcasting system is a specific type of multichannel telecommunication system, which for most operators has an analog component of 60 - 70 channels. The report is supposed to consider as an example such a laboratory complex created with the participation of the authors of the report (Fig. 1).



Fig. 1. Equipment of the head station.

To teach students the technology of forming a group signal with frequency division of channels, you can clearly use the modulators of the head station of the cable television system. When developing methodological materials, original developments were used [1-4].

Analog multichannel systems on the primary network have long been decommissioned, but the principles of their construction need to be studied, which is possible using the example of equipment for cable television broadcasting systems.

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УДК 159.9

THE RESEARCH OF SHORT-TIME STRESS PHENOMENON AS POTENTIAL INTUITION FACTOR

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Continuous long-time stress may cause significant health abnormalities and can be the reason of our unluck, sufferings in according to study [1]. Stress is one of the most interesting problems in psychology science. Stress influence causes many adverse reactions. Particularly, many people cannot concentrate on anything thus ability to be creative or intuitional thinking is getting worse. That is a very relevant problem in many fields.

On the other hand, there is a short-time stress (STS). In according to Ministry of Health of the Republic of Tatarstan data [2], STS overall is positive phenomenon which helps to activate reserve possibilities thus stress (within reasonable limits) is necessary for us. This study is dedicated to STS research in Higher Education process.

Author of this study (Teacher) is an assistant lecturer at the department Department for Radio-Electronic and Telecommunication Systems (Institute for Radio-Electronics, Photonics and Digital Technologies) in Federal State Budgetary Educational Institution of Higher Education «Kazan National Research Technical University named after A.N. Tupolev-KAI». In this term teacher has laboratory works with first-year students: discipline calls “Program packets for engineering application”. Teacher understands that during education in University/Institute students will meet a lot of stress factors that is why at laboratory works he tries to build strong feedback, friendly attitude with students and to create positive emotional background. However, students have to take their reports and to answer for several questions at every laboratory work: that is the moment when Teacher becomes demanding. Reports defense begins approximately 90-60 minutes before the end of the scheduled laboratory works. Laboratory work reports defense is the field for this study.

Teacher asks student a question about present laboratory work or past laboratory works. If student gives correct answer within 1 minute, then this case does not include in sample for this research. If student does not give the correct answer or silent in 1 minute period, then Teacher evaluates it as a potential unknowledge and this case includes in sample for this research. That is the moment when Teacher says “30 seconds” (STS onset). It is necessary due to laboratory works time limits (main reason) and high quantity of students which have to take reports (secondary reason). After time is up Teacher says “Answer” (STS offset).

Myers D.J. in study [3] describes intuition as instantaneous ability to know without preliminary observations. Some scientists gave definition for term “intuition” as sudden, complete and accurate comprehension. Student that gave correct answer could make it due to intuition or thinking – it is unknown, unfortunately. That is why we cannot call student’s correct answer under STS influence as intuition overall but because there is short-time limit for answer, we can form the hypothesis about intuition elements presence within the time period and call described phenomenon as potential intuition (PI).

As a consequence, there is one of two possible cases takes place during STS influence:

1. Student gives correct answer.
2. Student is silent.
3. Student gives incorrect answer.

In this study case №1 is classified as Positive potential intuition (PI+) and cases №2 and №3 are classified as Negative potential intuition (PI-).

Study scheme in the terms of time distribution is presented at Fig. 1.

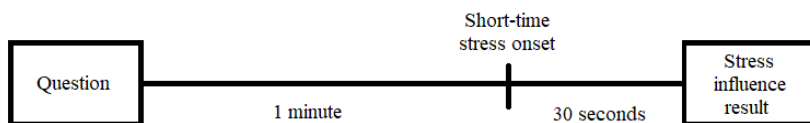


Fig. 1. Study algorithm.

In according to personal observations during the work experience, there are some persons that give the correct answer within these 30 seconds. That is why another hypothesis which formed within this study is concerned of STS positive influence on PI due to students’ correct answers presence during described 30 seconds.

First-year students of Institute for Radio-Electronics, Photonics and Digital Technologies studying at specialty 11.03.02 Infocommunication Technologies and Communication Systems (groups 5105, 5106, 5107) were enrolled in this research. Sample size for this study was 64 STS cases overall (registered within October 2021 among 14 laboratory works): 26 STS cases with PI+ (40,6%) and 38 STS cases with PI- (59,4%). In according to results, it is preliminary confirmed that STS impact can have positive influence on PI.

Results of this research confirm the study made by Rudland J.R., Golding C., Wilkinson T.J. [4]. In study [4] authors research eustress (positive stress) aspect. They formed hypothesis which is concerned to correlation between stress negative associations and its negative impact thus eustress impact can reduce distress (negative stress). Eventually, authors made a conclusion that stress positive associations may contribute to more effective studying and learning. It is possible to suppose that some students with PI+ cases also could have been under eustress impact or have not thought about something negative. Study [4] concerns health professional educators but, in personal point of view, results of study [4] could be and should be practically applied to other fields because modern life is full of distress, in personal opinion.

Another interesting study that can explain results of this research is made by Radtke E.L. et al. [5]. In study [5] authors researched a problem which is related to correlation between personality in the terms of emotion regulation abilities and cognition, intuition thinking, creativity or performance overall. After analysis of 49 participants authors made following conclusions:

- First, during low cortisol (stress hormone) impact participants with low emotion regulation ability overperformed with high emotion regulation ability.
- Second, as converse, during high cortisol impact participants with high emotion regulation ability overperformed with low emotion regulation ability.

Thus, students with PI+ could be STS-unresponsive with low emotion regulation ability or vice versa STS-responsive with high emotion regulation ability and PI- could be classified as STS-unresponsive with high emotion regulation ability or STS-responsive with low emotion regulation ability.

Future researches will be dedicated to sample size increase with the purpose to analyze results more concrete and from different aspects. It is also planned to perform experiments with decreased STS time period (for example, 10 seconds) with the purpose to determine correlation between STS durations in PI+ cases.

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УДК 621.317+611.127

THE RESEACRH OF VENTRICULAR LATE POTENTIALS USING SIGNAL-AVERAGED ELECTROCARDIOGRAHY IN DRIVERS' ELECTROCARDIOSIGNALS

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In according to Federal State Statistics Service (Rosstat) the amount of traffic accidents in Russian Federation has been decreased in recent years. Nevertheless, traffic accidents with victims are still classifying as a relevant problem [1].

The most frequent reason of death (including sudden death) in Russian Federation is cardiovascular diseases: 47% of cases, more than half of them because of ischemia [2].

Frequent reason of traffic accidents is driver's sudden health decline, for example, heart attack. Ventricular late potentials (VLPs), in particular according to Hashimoto K. et al. [3], are classified as predictors of cardiovascular diseases (including life-threatening).

VLPs are low amplitude (less than 30 μ V) electrocardiogram signal (ECS) elements, located at the late part of QRS-complex. VLPs registration will be useful for health's preventive measures.

The main goal of this research is to confirm an opportunity to register VLPs by Ist standard lead (from hands). The main advantage of ECS' analysis by Ist standard lead is ease of registration. In this case registration equipment, for example, electrodes, may be installed on steering wheel. The following tasks are solved in this work with the purpose to achieve the main goal:

- Evaluation of VLPs presence or absence using Simson's approach [4] to ECS registered by Frank orthogonal leads X, Y, Z.

- Practical application of Simson's approach to ECS registered by Ist standard lead using threshold parameters. Efficiency analysis of Simson's approach application with mentioned threshold parameters to ECS registered by Ist standard lead.

ECS of 72 persons with myocardial infarction are analyzed within this investigation. 200 records of ECS by X, Y, Z leads and 200 records of ECS by Ist standard lead are analyzed overall. ECS records are taken from PTB Diagnostic ECG Database from open-access electronic source Physionet. Duration of most ECS records is about 2 minutes, noise level is less than 0,5 μV , sampling frequency – 1 kHz, 16-bit resolution. MATLAB programming complex is used for research. Example of analyzed ECS is presented at Fig. 1.

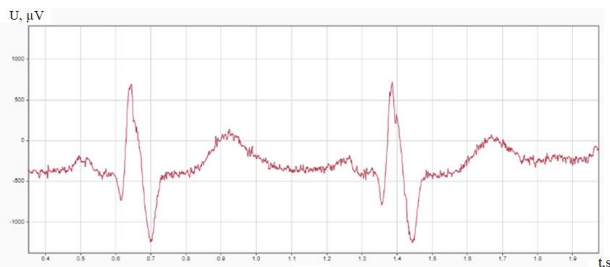


Fig. 1. Fragment of analyzed ECS (Ist standard lead).

Filtering within the range of 25÷250 Hz is used to remove low-frequency trends and high-frequency noises. Filtering is performed in Signal Analyzer app from DSP System Toolbox utility. Notch finite impulse response filter in Signal Analyzer app is used to remove 50±1 Hz noise. This range is selected by ECS spectrum's visual analysis: in case of range expansion frequencies near 50±1 Hz (useful information) are reduced. Mentioned noise is reduced on 20÷25 dB on average.

Next step is cardiac cycles (CC) extraction. R-peaks of preprocessed signals are selected as a synchronization points. Cardiac cycles with 512 ms duration in according to [4] are analyzed for this research. Extracted CC coherent accumulation followed their averaging are made with the purpose to increase signal-to-noise ratio. An example of accumulated CC from X, Y, Z leads is presented at Fig. 2.

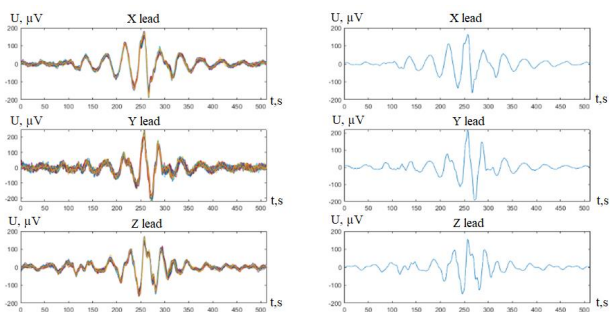


Fig. 2. Filtrated CC (compilation and averaged).

Vector magnitude at Frank leads is determined in according to equation 1:

$$\rho = \sqrt{U_x^2 + U_y^2 + U_z^2}, \quad (1)$$

where U_x , U_y , U_z – voltage values in CC extracted from ECS by X, Y, Z leads.

For Ist standard lead vector magnitude is determined in according to equation 2:

$$\rho = \sqrt{3U_I^2}, \quad (2)$$

where U_i - voltage values in CC extracted from ECS by 1st standard lead. Three-time multiplication presence in equation (2) is related to three-lead analysis by Frank. As a result, vector magnitudes comparison correctness is secured.

Filtered QRS onset and offset points are determined in according to algorithm presented at [5].

In this research we analyzed following threshold parameters:

a) Duration of filtered QRS-complex $D_{fqr} > 120$ ms;

b) Low amplitude signals less than $40 \mu V$ at the late part of filtered QRS-complex $LAS40 > 39$ ms;

c) Root mean square at last 40 ms of filtered QRS-complex $RMS40 < 25 \mu V$.

If at least two mentioned conditions complied then a decision of VLPs presence at ECS will be take. The cases of VLPs presence at X, Y, Z leads and 1st standard lead are presented at Fig. 3,4.

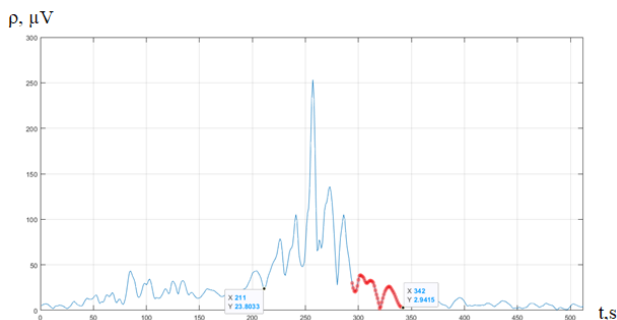


Fig. 3. VLPs presence at Frank leads.

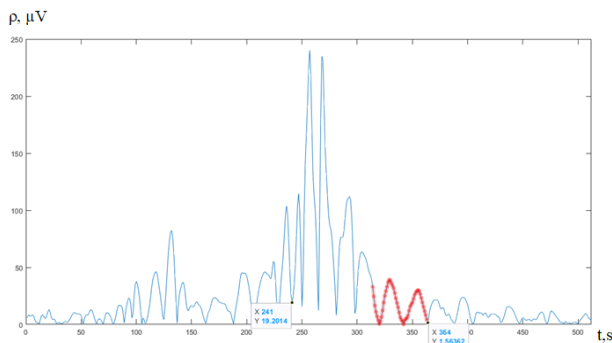


Fig. 4. VLPs presence at 1st standard lead.

VLPs presence is registered in 10 ECS records by X, Y, Z leads. In 3 of these 10 cases VLPs presence is also registered in ECS records by 1st standard lead.

Due to results of research an opportunity to register low amplitude predictors of arrhythmias at drivers' ECS from hands is showed. It is planned to increase the amount of ECS records and to refine VLPs presence or absence threshold parameters in ECS by 1st standard lead for further researches.

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УДК 004.032.26

USING CONVOLUTIONAL NEURAL NETWORK TO DETECT PNEUMONIA ON X-RAYS

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The outbreak of coronavirus infection began in December 2019 and spread around the world. The number of infected and deceased patients is growing at a high rate. One of the factors influencing the mortality rate in coronavirus is how early the disease was detected. As a result, we need to solve the issue of proactive forecasting.

Radiography or computed tomography of the chest organs is used to diagnose coronavirus [6]. Currently, the diagnosis of lung diseases using regression neural networks is used [2], algorithms for diagnosing tuberculosis and pneumonia based on segmentation using a decision tree, the Bayesian principle [4], and methods of deep machine learning that have replaced the above approaches [5,1]. Considering modern technologies, it is reasonable to use the capabilities of neural networks to detect individual pathologies in medical images.

To solve the problem of object detection, we will use convolutional neural networks. In particular, among the various architectures of convolutional neural networks, You Only Look Once was chosen. The main feature of this architecture is that unlike most other CNN architectures, which are applied several times to different regions of the image, in YOLO CNN is applied once to the entire image at once.

A part of the open database of Chest-ray8 images was used as training and test images[7]. This database consists of digital images of chest radiographs in a direct projection with a size of 1024*1024 pixels in JPEG formats. The total number of images is 112 120 images of 30805 patients, also in the set there is: a test sample containing 30500 images, a test sample that has the same dimension as the test one. Such a large amount of data will allow us to obtain the most correct results and estimates of this model.

The training takes place according to the YOLO algorithm and the model at the end of the training will have 106 layers according to the architecture, of which 53 will be only convolutional. The resulting model was trained for 135 epochs, for the first 75 epochs with a learning step of 0.01, the next 30 epochs with a step of 0.001, and the last 30 epochs with a step of 0.0001.

At the end of the training, this model was able to obtain an average probability score for predicting an object, in this case pneumonia, equal to 0.7. This result corresponds to the architecture of a neural network, the essence of which is the speed of detection, with a relatively significant error.

Thus, the results obtained allow us to assert that the use of this algorithm for the detection of pneumonia is possible, however, due to a rather significant error for this application area, only as a companion program that would help the doctor to detect pathologies faster on X-rays.

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УДК 66

APPLICATION OF MOLECULAR DYNAMICS METHODS TO PREDICT MISCIBILITY OF POLYMER/SOLVENT SYSTEM

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One of the main ways to synthesize new composite materials is to obtain a new polymer with improved properties, which is achieved by mixing other polymers and various additives with the original polymer. In this case, predicting the mixing process and the solubility of various substances can significantly reduce the time and resources required for research, as well as reduce the amount of waste, which is a task of urgency.

Molecular modeling methods are ideally suited to predict the mixing process and solubility, in particular, molecular dynamics method, which allows to study various physico-chemical processes.

The objective of this research is to obtain a general algorithm for the process of constructing a computer model of the mixing process of the polymer/solvent system with the identification of the nature of their interaction.

High-temperature thermoplastics - polyestersulfone was chosen as the polymer. The solvents in this case will be N-methylpyrrolidone, N, N-dimethyl sulfoxide, N, N-dimethylformamide and dimethylacetamide.

To carry out the simulation, elementary chemical structures of solvents and polymer have been first created. In order to achieve the most reliable result on 3D models, it was required to additionally perform geometric optimization of the structure. The result is shown in figure 1.

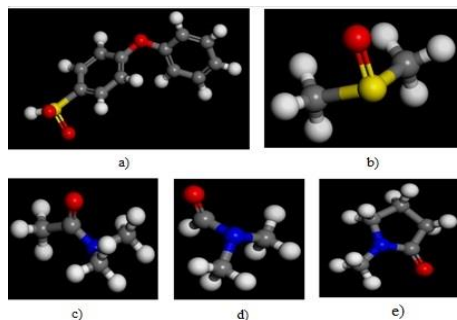


Figure 1 - 3D models: a) ethersulfone; b) dimethyl sulfoxide; c) dimethylacetamide; d) dimethylformamide; e) methylpyrrolidone

Optimized models can be analyzed for miscibility at different temperatures. In the case of this research, the temperature range was chosen from 0 to 150°C. Figure 2 shows an assessment of the effect of temperature on the solubility of ethersulfone in various solvents.

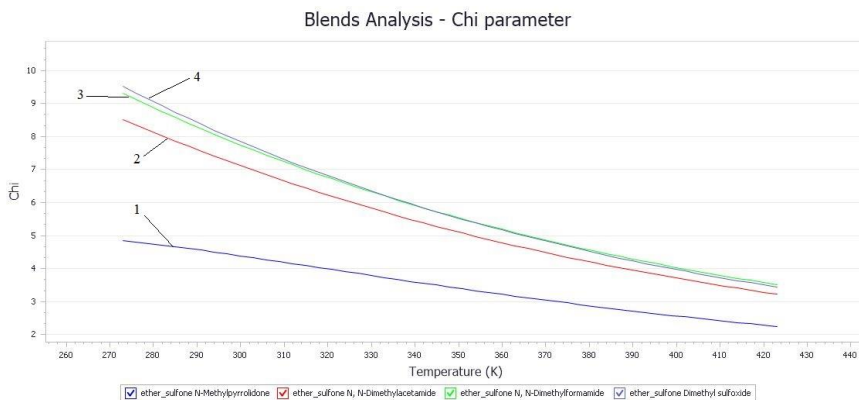


Figure 2 - Solubility of ethersulfone in solvents: 1 -methylpyrrolidone; 2 - dimethyl sulfoxide; 3 - dimethylformamide; 4 - dimethylacetamide

The value of miscibility is the parameter χ ("chi"), which is determined by the nature of the substances being mixed. The lower the value of χ , the more soluble substances are in each other [1]. The figure 2 shows that methylpyrrolidone provides the best solubility of ethersulfone over the

entire temperature range. It is also worth noting that with increasing temperature, the solubility of all polymer/solvent systems increases.

These systems are difficult to accurately measure for miscibility in practice and compare with the results obtained. However, with the help of this simulation, one can at least empirically imagine how a particular substance conducts when mixed with another substance at different temperatures.

Yet, the simulation results are far from being considered ideal. But still, the use of molecular modeling methods makes it possible to at least superficially assess certain processes occurring in polymers and predict their behavior, which will be of a great assistance in research.

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УДК 621

DESIGN AND DYNAMIC MODELLING OF A POWER SUPPLY SYSTEM FOR A CARRIER ROCKET

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In recent years the most relevant and promising area of application of unmanned aerial vehicles has become the delivery of payload into orbit. This evidenced by the significant technological growth of the following western companies: SpaceX, Blue Origin and Virgin Galactic. Competition in this area has led to the fact that Elon Musk's company SpaceX was able to safe first rocket's stage for reusing and returning it back to earth. This has significantly reduced the cost of launch. Rocket construction costs more than a half of a space launch. Creating reusable vehicles will give SpaceX a big advantage over its competitors. Also, the multiple use of accelerators gives a great economic effect, since the cost of the first stage is 60–70% of the price of the rocket itself. Thus, Elon Musk threatens the Russian space industry: Russia was ousted from the market for delivering cargo to orbit, because technologies could not offer a lower launch price. Also the number of operating spacecraft in orbit: only about 10% belong to Russia. These are mainly GLONASS satellites, as well as military navigation and communication. In terms of the number of satellites, Russia four times behind the United States, where most of the devices are responsible for commercial communications. Russia maintained its leading position in the commercial space delivery market from 2011 to 2019. The nine-year pause in American manned space exploration was due to the absence of its own manned spacecraft after the closure of the Space Shuttle program. Thus, the goal of this work is to develop a power supply system for an aircraft capable of competing with Western counterparts and returning Russia's leading position in the space industry.

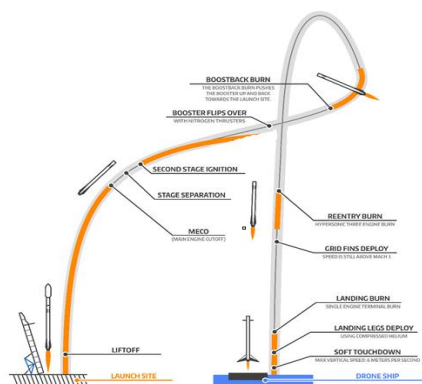
The «Amur» launch vehicle is a Roscosmos project developed in October 2020. It is assumed that in 2026 it will be able to replace Soyuz-2 launch vehicles. Special ability of this apparatus is its reusability, which is achieved by the ability to return to the ground. This happens in following algorithm (picture 1).

1. Return impulse

When returning to the launch place, rocket uses continuous engagement of the engines to reverse its direction of motion, performing a complex loop.

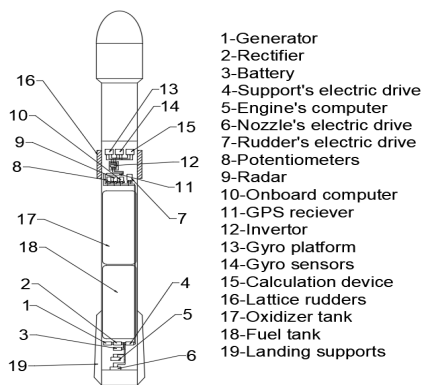
2. Landing impulse

During the vertical landing, rocket brakes by starting the engines. Immediately before the landing, landing supports deployed to ensure softness.



Picture 1 – Rocket's trajectory

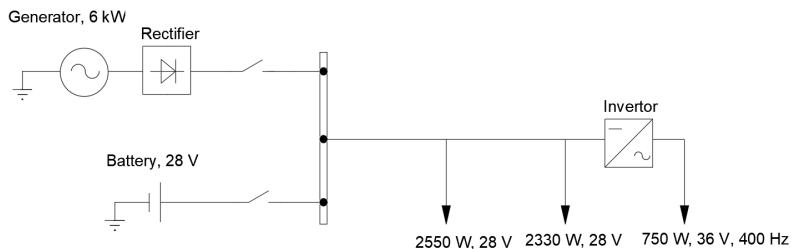
The idea of project is to think about how power supply system can works on the vehicle like «Amur». First step was a list of power consumers and their placement on board (picture 2). Summary consumption attains about 6 kW, this was the initial data for choosing power sources.



Picture 2 – Device's placement

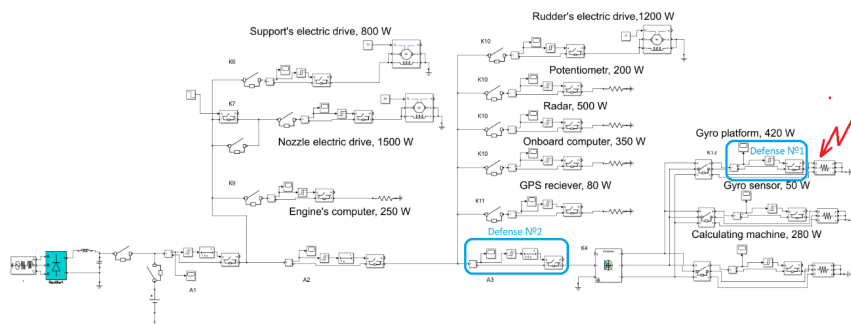
Goal of next step was to choose power sources. They were generator and an accumulator battery. Generator has to work most part of the time if power system functions properly. Battery has to be a reserve power source. Certain types of current can provide secondary power sources that are rectifier and invertor. A rectifier transform alternating current into direct one, whereas an invertor does it vice versa. [1]

The goal of next step was to determine configuration of a circuit. On picture 3 there is an illustration of it. Here we can see the three groups of consumers. Two of them get energy from the generator through rectifier or from the battery. The third consumer gets energy from an invertor. [2]



Picture 3 – Circuit's scheme

In the next stage of our research we designed above electric circuit in MATLAB Simulink to test power supply system in different modes (picture 4).

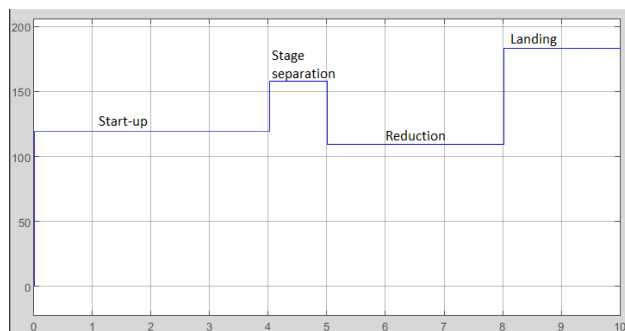


Picture 4 – Matlab simulation

The first experiment was to test circuit defense system. This system used to prevent vehicle from damage. It works in following algorithm: if short circuit happens then defense must disable the damaged component. Also protective relay implies selectivity. It means that if one device fails then the other must continue to trip. The first device works immediately and disables only the damaged component, the second one works in about half of a second and disconnects the bigger part of a circuit. Also the second device is closer to power source. [3]

Then it was testing how backup power sources work. When failure on generator occurs, battery must automatically be added to the circuit. To work properly it must take no more than 80 ms for a source change.

The target of the last experiment was to simulate the full research cycle. It's important to understand current load in different modes, because it influences on cables size. There is a higher load at the landing stage it means that all cables must be chosen according to the currents on these stage (picture 5).



Picture 5 – Full cycle

In conclusion there is an outcome of all the obtained results. It is possible to construct an unmanned aerial vehicle with ability to return to earth independently. Power system demands certain equipment and suitable sources. Summary power consumption was about 6 kW and it feeds it from generator and accumulator battery. Using Matlab Simulink program to simulate the electric circuit and check it in various modes is the best variant. Also it was useful to understand the current levels during the flight. At least it would be fair to say that system works properly.

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УДК 53.07

AN OVERVIEW OF THE APPLICATION OF SDR TECHNOLOGY IN THE INFORMATION SECURITY DOMAIN

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The paper deals with the application of SDR technology in the information security domain. The purpose of this work is to study the possibility of intercepting and restoring signals by using a software tool developed for an SDR receiver.

A software-defined radio (SDR) system is a transceiver that uses technology, the essence of which is that the basic parameters of the transceiver are determined by software, not hardware configuration. In other words, much of the digital signal processing takes place directly on the computer.

A simplified SDR architecture is shown in Figure 1. [1].

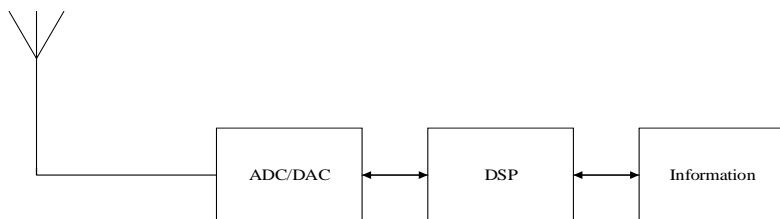


Figure 1 — Simplified SDR architecture

SDR contains blocks of analog-to-digital converter (ADC), digital-to-analog converter (DAC), antenna, digital signal processing circuits and other auxiliary blocks. The ADC connects directly to the antenna and converts the time-continuous signal into a digital binary code. The DAC performs the reverse conversion. A digital signal processor (DSP) is used to carry out the calculations required to execute the signal processing algorithms.

Figure 2 shows the functional diagram of the SDR [1].

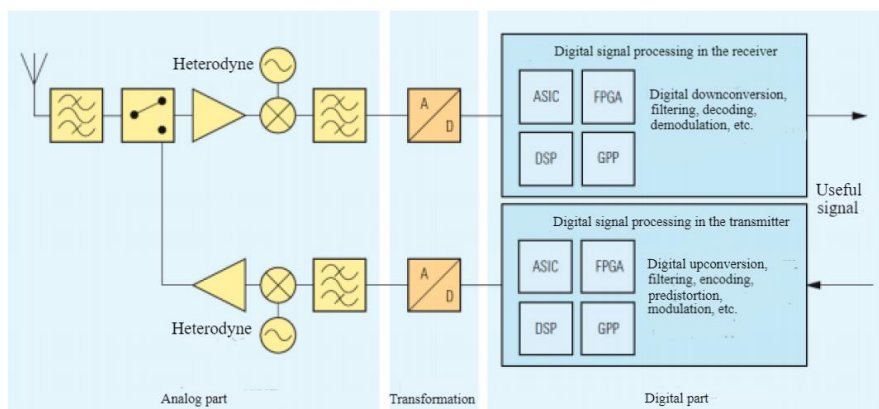


Figure 2 — Functional diagram of SDR

The device is made according to modular architecture and contains a radio frequency module, a data conversion module, and a digital signal processing module.

SDR technology is based on two principles:

- transmission of a broadband signal from a radio receiver to a computer. The processed bandwidth can be from 48 kHz (PC sound card) to 50 MHz (ultra-fast ADC with signal transmission over Gigabit Ethernet or USB 3.0);

- signal demodulation on PC using mathematical algorithms.

Existing SDRs can be divided into 3 types [2]:

- models based on a sound card. The signal is transmitted to the line-in via an audio cable.
- models with built-in ADC and transmitting signals in digital format. These models are built on the principle of a heterodyne receiver.
- models with built-in ultra-fast ADC. Such an ADC digitizes directly the input signal from the air.

Currently, SDRs of 2 and 3 types are most widely used.

SDR receivers in information security can be used for:

- search, measurement and visualization of compromising radiations [3, 4];

- radio monitoring [5].

Attempts have been made for a practical attack on the PC video path via the compromising radiation using an SDR device [3].

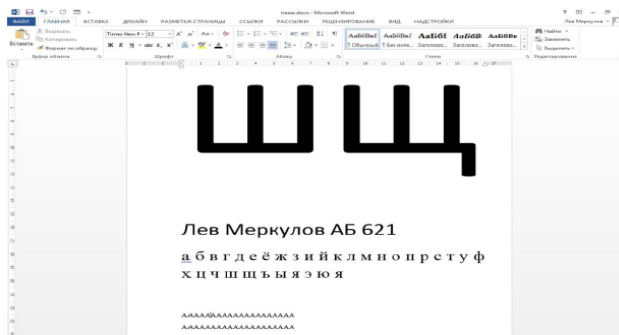


Figure 3 — Snapshot of the working screen of the monitor under study

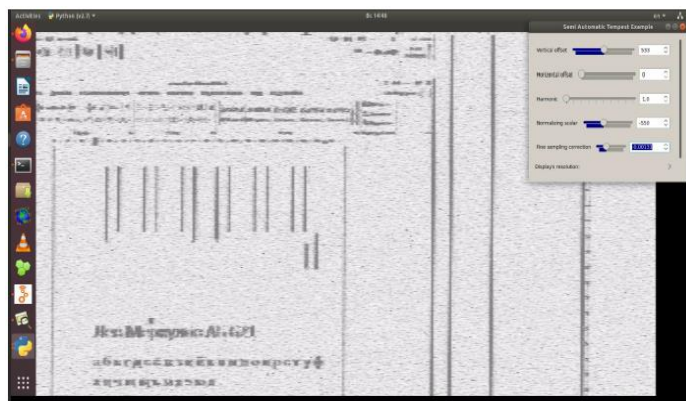


Figure 4 — Attack result

Figures 3 and 4 provide an opportunity to illustrate the possibility of visualizing the compromising radiation signal using an SDR device.

In the study [4], an experiment was also carried out to recover compromising radiation signals using an SDR device. The quality of the reconstructed image is better due to the use of an SDR device with better characteristics and due to the experiment in an anechoic chamber. The anechoic chamber made it possible to exclude extraneous signals in the investigated frequency band.

In the course of work [5] systematized information about the technical characteristics of the means of covert reception. The frequency ranges of the wireless communication facilities are presented. Various methods of searching for radio burial devices are considered. The process of radio monitoring and the algorithm of the complex operation based on the SDR receiver was presented.

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УДК 514.8+620.179.15

ALGORITHM FOR LOCAL TOMOGRAPHIC RECONSTRUCTION OF A SLIM DEFECT

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The method of computational tomography makes it possible to study in detail the internal structure of heterogeneous objects (products) of complex shapes, without subjecting the object itself to significant changes. However, the complexity of processing the test results remains very high with a significant cost and complexity of the equipment. It is necessary to develop new, economical reconstruction algorithms for the mathematical support of solving industrial tomography problems.

The algorithm described in this work is based on the idea of using a reference sample of the object under study [1]. The researcher is provided with a projection matrix obtained for the reference sample (without defects), then the matrix obtained for the tested product is compared with this matrix. If they differ within acceptable limits, then the next product is taken, otherwise distorted elements are selected, using which, without reconstructing the entire object, the detected defect is localized on the tomogram.

X-rays are used as probing radiation. The radiation source is located on the boundary of the object, which is a circle of radius R . The problem under consideration is two-dimensional, the rays are fan-shaped chords, as shown in Fig. 1, the defect is a sinusoidal region. N is the number of rays, M is the number of source locations. A set of measurements for one position of the source is called a projection. Placing the obtained projections in the form of the corresponding matrix rows (the first row is the first projection, etc.), we obtain a projection matrix, the elements of which represent the characteristic of the ray based on the density of the material passed by it [2].

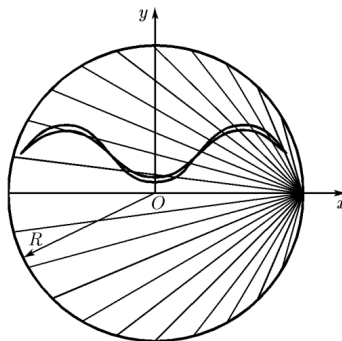


Figure 1. Product model with defect

It is assumed that there is a defect D of a very thin elongated structure and zero density inside the circle. This assumption makes it possible to simulate at once the "working" matrix P , the elements of which represent the differences of the corresponding elements of the projection matrix for the reference object and the projection matrix for the tested object. Only those elements of the working matrix that correspond to the rays passing through the defect will be nonzero elements.

Having selected the maximum element in each row of the "working" matrix, we obtain a sequence of numbers P_i , where

$$P_i = \max_j \{P_{i,j}\}.$$

We transform this sequence into a vector P^1 , arrange it in descending order and get a working vector. Note that each element of the working vector is assigned two numbers i and j , defining the corresponding ray.

The following simple way to localize a defect is possible. Each selected ray can be drawn using the numbers i and j stored in special arrays. To do this, you just need to know the number of vector elements P^1 that will be used. For this purpose, a graphic image of the vector elements P^1 is built (Fig. 2, a), then L (the number of the first elements of P^1 used) is visually determined using this graph. Next, we outline the image of the defect in the rays (Fig. 2, b). Then a tomogram is constructed, on which the image of the defect remains, rid of unnecessary parts of the rays (Fig. 2, c).

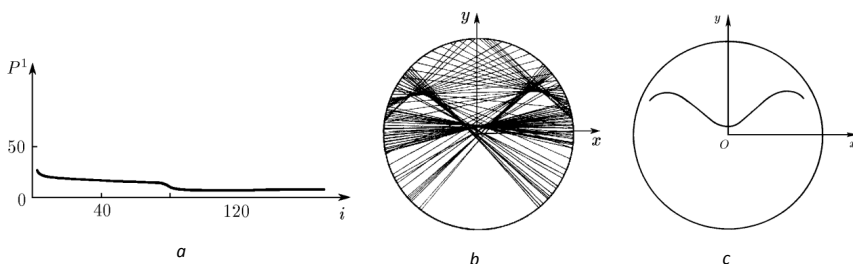


Figure 2. The result of applying the tomographic reconstruction algorithm (a is the graph of the elements of the vector P^1 , b is the image of the defect in the rays, c is the restored defect)

In conclusion, we note that the proposed method, which makes it possible to significantly reduce the consumption of computer time when processing experimental information, is intended for the prompt detection of thin extended defects such as delamination or cracks. The high sensitivity of the developed algorithm is determined by the multivariate measurement method and does not depend on the orientation of cracks and delamination. In contrast to the well-known mathematical methods used in two-dimensional tomography [3,4], the developed method allows the reconstruction of the most important parts or part of the complete section as a result of local x-ray transmission through them.

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УДК 621.311

INVESTIGATION OF CURRENT PROTECTIONS IN DISTRIBUTION NETWORKS WITH DISTRIBUTED GENERATION SOURCES(RES).

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The introduction of renewable energy sources in the electric grid is currently one of the urgent problems in the energy sector. However, there are many reasons that have a retarding effect on these events. One of the difficulties on the way to solving problems with energy by introducing renewable resources is changing the operating modes of the network, which in turn can have a significant impact on the functionality and operation of relay protection and automation [1].

The use of a large number of renewable energy sources and the dependence of their position in the network as distributed sources significantly affects the value of short-circuit currents and their directions [2].

Let's consider the main problems faced by the energy sector when introducing renewable energy sources into the distribution network.

1. Influence on the sensitivity of relay protection.
2. Influence on the selectivity of relay protection.
3. Influence on automatic reclosing.

To solve these problems, the schemes for the study of various influences mentioned above have been experimentally created. As it turned out, the usual methods of protecting network objects with RES cannot provide proper control [3]. Possible answers to these problems are suggested below.

1. Mandatory voltage sensing of those sections of the network where RES is directly connected. This method is relatively cheap, but it cannot guarantee 100% protection, since the large distance of the short circuit point from the control site affects the sensitivity of the protection.

2. Using remote protection instead of the maximum overcurrent protection that is commonly used in distribution networks. This type of protection is less susceptible to changes in the power grid. However, the introduction of a large number of renewable energy sources leads to mandatory consideration of transient resistance, which in turn affects the scope of remote protection.

Thus, the lack of methods for the correct operation of relay protection during the introduction of renewable energy sources complicates their widespread use in distribution networks around the world [4]. Consequently, there is a huge need to study this aspect of the issue, since the integration of renewable resources into electric power systems is one of the highest priorities in the energy sector.

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ROTOR BLADES OF A FREE TURBINE OF A GAS-TURBINE ENGINE: INCREASED OPERATING TIME RESEARCH

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The types of damage to the rotor blades of a free turbine of a gas-turbine engine (GTE) were systematized in the context of their service life.

The free turbine of the GTE is designed to convert the energy of the gas flow into mechanical energy of rotation of the turbine rotors [1, p.63]. The rotor blades of a free turbine unit are important parts of a gas turbine engine. They provide the conversion of part of the gas energy into the rotational energy of the compressor. Every 10 thousand hours, the blades are subject to inter-resource repair. To identify defects and damage, visual inspection, tests of mechanical properties, and long-term strength and microstructural analysis are carried out.

The object of the study was GTE blades with an operating time of 95473 hours, taken out of service in 2020. A fatigued blade was found in the engine, which caused a breakdown of the entire rotor blade wheel of a free turbine. Such phenomena are not typical for free turbine blades [2, p. 34; 3. p. 182]. As a result, according to the terms of reference, a metallurgical study of the entire set of blades was carried out, in which: visual inspection and photography under a binocular, analysis of fractures, micro-examination, testing of mechanical properties, spectral analysis.

In the fracture (Figure 1) of the blade, two zones of development are noted, differing in the structure and colors of oxidation.

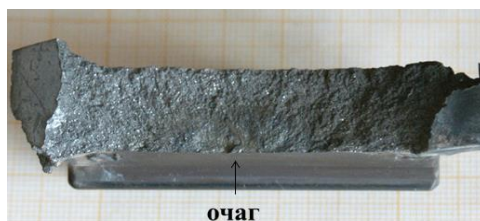


Figure 1 - Fracture of the rotor blade of a free turbine in the AST-282008 engine

1st zone - fatigue failure, oxidized to golden brown color.

2nd zone - dolom zone: fracture static, grain structure. There is oxidation to a dark gray color.

Due to the detection of the manifestation of metal fatigue, the question was raised of reducing the service life of the rotor blades of a free turbine of a gas-turbine engine. However, by examining the remaining fractures of the remaining blades of the set, it was found that the fractures are of a static nature, with a granular structure. The fracture surfaces of most blades are partially clogged and covered with oxide deposits. There are no metallurgical defects in the preserved fracture sections.

To collect statistical data in order to confirm the serviceability of free turbine rotor blades with increased operating time, it was decided to test free turbine rotor blades with increased operating time of 70,000-90,000 hours, removed from 17-20 engines. The task was set to analyze the presence or absence of changes in the microstructure, long-term strength and mechanical properties from operational influences, depending on the operating time.

Mechanical tests were carried out on samples with a diameter of 5 mm, made from the blade lock. According to the test results there is no definite regularity between the mechanical properties and the operating time.

Microstructural analysis was carried out using a scanning microscope. Samples were made from the locking part and the blade. The microstructure of all blades is similar and is represented by the γ -solid solution, particles of the eutectic γ/γ' -phase of a cubic shape, carbide particles along the grain boundaries (Figure 2) [4, p.146].

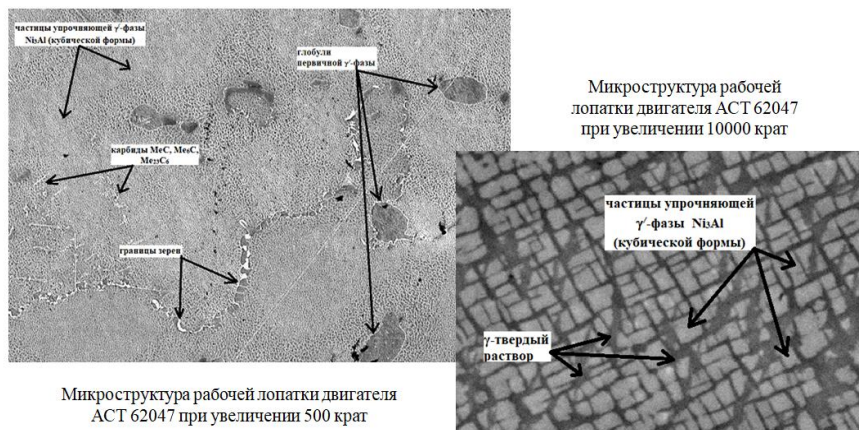


Figure 2 - Microstructure of the rotor blade

There are no signs of exposure to high temperatures and material degradation, which confirms the satisfactory quality of the material.

According to the results of macro- and microstructural studies and mechanical tests of the rotor blades of a free turbine, it has been revealed that there are no fatigue changes in the structure and properties of the metal. It has been established that the main types of defects in the rotor blades of a free turbine, both with a short operating time and a long operating time, are various nicks when foreign objects enter. And the destruction from fatigue of the scapula ind. No. M9660-1 engine AST-63059 discussed above is an atypical case, since these blades do not carry high operating loads and operate at a relatively low temperature.

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EFFICIENCY OF SOLIDS TRAPPING IN THE SEPARATOR WITH COAXIALLY ARRANGED TUBES

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An important task of most industrial enterprises is qualitative purification of gas streams from fine particles smaller than 10 - 20 microns. Frequently, uncollected fine particles lead to failure of apparatuses, due to their clogging with various grains and dust. Tightening of ecological requirements to maximum permissible emissions of harmful substances into the atmospheric air and increase of production capacities of enterprises, as a consequence, use of equipment at maximum capacities or connection of additional units require from enterprises more thorough cleaning of gas emissions. Also fine particulate matter is very harmful to human health and especially to employees of the enterprise. According to the World Health Organization, 9 out of 10 people breathe polluted air and about 7 million people die each year from the effects of inhaling such air containing particulate matter. Dust is a Class 3 hazard. Large particles of dust (10-100 microns) are trapped in the upper respiratory tract, while fine particles (less than 5 microns) can penetrate deep into the respiratory tract and affect the pulmonary parenchyma.

To date, special attention is focused on improving the efficiency of capture of fine particles less than 10-20 microns. This problem is urgent for many industries. Fine disperse particles can lead to device failure or put it out of operation completely by contamination. Also, uncollected fine particles often cause reduction of device properties, increase hydraulic resistance of pipelines and can lead to explosive and fire hazards. For example, at gas-distributing stations fine particles, if they get into technological and gas regulating equipment, disturb its operation [1]. In some cases fine particles are valuable material, which can be reused in various processes and for production of various products.

Cyclone separators are one of several contaminated air filtration devices because they remove large particle fractions. This helps the finer filtration filters, which are installed after the cyclone separators, to fight coarse contaminant particles and filter out only small fractions, thereby ensuring a long service life of the filtration plant. In addition, several cyclone separators can operate in parallel, and this system is known as a multi-cyclone system.

It is important to note that cyclones can vary greatly in size. The size of the cyclone depends largely on how much air needs to be filtered, hence, larger volumes - require larger cyclones. For example, there may be several different models of the same type of cyclone, and sizes can range from a relatively small 0.2 meter high to 1.8 meters [1-2].

In a cyclone separator, the contaminated gas stream flows into the chamber. Inside the chamber, the air flows in a spiral, like a tornado, starting from the upper part of the cyclone. Clean air has less inertia, so it, due to the shape of the chamber, flows further along the main line, and the solid particles are filtered out under the influence of the inertial centrifugal force. The particles hit the inner walls of the chamber and sink into the collection vessel. The lower part of the chamber is shaped like a cone, thus contributing to the settling of particles in the hopper. The cleaned air moves further along the line through the upper part of the separator. Mainly cyclones are built for filtration of contaminant particles with diameter more than 10 microns.

Of all compressed air filtration devices, cyclone separators are among the least expensive. They are mainly used for pre-filtration, so that the air enters the filter with fewer contaminants.

The advantages of cyclone filters are:

1. Generally, cyclone filters can remove most all contaminants in compressed air, but this depends largely on the size of the particles;
2. Cyclone separators are not expensive to install and maintain, and have no moving parts. This

is what keeps maintenance and operating costs down.

3. Filtered solids are collected in a dry state, which makes them easier to remove.
4. Takes up a small footprint and has the ability to operate at high temperatures.
5. Cyclone filter helps save money by extending the life of bag and cartridge filters. It traps most dust particles before they reach the filter elements, so they won't fill up as quickly.

There are many types of cyclone separators, which can be conventionally classified into counterflow cyclones, straight-flow cyclones and vortex dust collectors (VCP) or counter-current dust collectors (CFD).

The most common dry mechanical dust collectors are return-flow cyclones. Both cylindrical and conic cyclones are used for dust cleaning.

The main parameters, characterizing cyclone operation, are cleaning efficiency and hydraulic resistance, which depend on the design features of the apparatus and the velocity of gas flow.

Attempts to reduce the hydraulic resistance of cyclone dust collectors with simultaneous reduction of dimensions and obtaining a number of other advantages have resulted in the development of direct flow cyclones.

Direct-flow cyclones are significantly inferior to return-flow cyclones for the following reasons:

1. significantly less elaborate technical characteristics;
2. insufficient data on industrial application;
3. absence or difficult accessibility of the necessary technical documentation for their inclusion in the designs and for manufacturing.

Vortex dust collectors (VCP) were developed much later than cyclones. Over the past time a number of designs of VPU were created.

The main advantages of VPU over cyclones are:

1. more intensive separation of particles along the height of the apparatus;
2. a wide range of gas and dispersed phase loads;
3. lower power consumption;
4. multi-nozzle input of the gas stream.

Having analyzed the existing designs of cyclone dust collectors, the following conclusions can be made:

1. Constant improvement of cyclone dust collectors has led to creation of a very wide range of apparatus designs (return-flow cyclones, direct-flow cyclones and vortex dust collectors).
2. Straight-flow cyclones are rationally used at lower requirements for the efficiency of gas cleaning, for capturing large dust particles and minimizing the energy costs of the process.
3. Vortex dust collectors have the highest efficiency of collecting fine dust, but they are more complex structurally.

Despite their effectiveness, there are disadvantages to using cyclone filters. Standard models cannot effectively clean small dust particles, as well as they have high operating costs.

The goal of our work was to develop a centrifugal separation device with coaxially located tubes, which would increase the efficiency of gas purification from particles up to 20 microns in size and increase the service life of the bag and electrostatic filter.

It is proposed to use this model to purify gas from fine dispersed particles smaller than 20 microns. The developed construction is installed between the first and the second stages of purification, i.e. between the bag and the electrostatic filter, also increasing their service life.

The separating device is a cylindrical body, inside of which there is an inner cylindrical tube with rectangular holes. At the top of the separator device is a central circular orifice that acts as an inlet nozzle. Towards the periphery from the inlet nozzle there is an asymmetrical series of circular orifices which form the outlet spigots from the separator device. The advantage of this separator is the ease of fabrication as the basic elements are cylindrical tubes. This difference makes it possible to manufacture the separator directly at the plant.

The principle of operation of the separating device can be described as follows: the dusty gas stream with fine particles up to 20 microns in size gets into the device through the inlet nozzle, then it moves downward along the normal relative to the bottom of the separating device; when the

stream reaches areas parallel to rectangular holes, it begins to spread evenly across them. It should be noted that the flow of dusty gas distributed through rectangular holes gradually changes its direction, which contributes to the loss from the flow of dust particles larger than 20 microns, which were not collected in the first stage of cleaning. Then each jet of dusty gas at the outlet of the rectangular holes is divided into two parts, which move in opposite directions relative to each other, forming vortices. The peculiarity of the separating device is that each vortex has contact points with neighboring vortices as it rotates. When neighboring vortices are in contact, additional mutual acceleration occurs. As it rotates, the gas flow rises through the intercylindrical space to the top of the device and exits the separating device through the outlets. It should be noted that during the rotation of the gas flow in the intercylindrical space of the device there are centrifugal forces of large values, contributing to the separation of fine particles from the dusty flow. When the gas flow is knocked out, the particles fall into the stagnant zones and settle at the bottom of the device or stick to the surfaces of the walls. [3].

Thus, a separator with coaxially located tubes has a simple design and high efficiency up to 99.9 % of trapping fine particles in the size range of 1-10 microns. To use the separator in gas purification processes it is suggested to place it after cyclone. Then the purified gas flow from solid particles up to 10 μm in size will pass through the separator after the cyclone.

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УДК 519.17

FINDING THE LONGEST PATH IN A DIRECTED CYCLIC GRAPH

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Introduction:

The Longest Path Problem – a problem from Graph Theory and Algorithm Theory which consists in finding the maximum path in a given graph. Certain related data can be represented as graphs. Many large companies such as Facebook, Amazon, Microsoft, and Google use them because they show the nature, depth, and interdependence of the relationships created by their business decisions. A graph is one of the most convenient and understandable ways to visualize information. It helps when solving problems related to paths (e.g. for transportation or Internet paths). They are an integral part in the representation and processing of BigData in large companies. [2]

When it comes to the problem of finding the maximum path for small graphs, i.e. for those with a small number of vertices and edges, it is not difficult. For small graphs algorithms of $O(n)$ complexity are usually used, where time of algorithm's execution depends directly on parameter n , which characterizes quantity of input information of algorithm, but in practice such graphs are rare. So a problem arises when the number of edges and vertices increases dramatically. Ordinary enumeration of values is extremely inefficient and it is necessary to resort to other processing methods.

Main part:

The algorithm will be used to solve the problem from IS (Information Security) – «Attack vector search». Attack vector search involves identifying anomalies of network activity by IP-addresses, so the most effective way will be to use graphs.

Attack vector – the longest vector, in an oriented graph of IP addresses of the following form: $((IP_1, IP_2), (IP_2, IP_3), \dots, (IP_N, IP_{N+1}))$, where each vector element is represented as an edge of the graph. The length of edges is unimportant here, so take them as one. Then the final value will have the following form:

$$(IP_1, IP_2, IP_3, \dots, IP_N)$$

The following tools were chosen to implement the algorithm:

- Python – programming language in which the algorithm will be implemented.
- Spark – framework for distributed big data processing. Will be used for initial data processing.
- NVIDIA Rapids – set of frameworks with implemented algorithms to solve many problems. All algorithms use the graphics processing unit (hereinafter – GPU) in their work.
- NetworkX – library for Python. Will be used to transpose a graph.

The main library used in the algorithm is cuGraph, one of the Rapids frameworks. It is needed to run the algorithms on the GPU, instead of the central processor (hereinafter – CPU). This choice was made to increase the number of threaded processes. The CPU cores are responsible for this indicator and cuGraph allows to use graphics cores instead of the usual ones, which are hundreds or thousands of times larger, which will greatly accelerate the calculation process.

The graph is a CSV table of edges called "srcdst-150221.csv". The graph itself contains 1840944 vertices and 7831764 edges.

Algorithms used from cuGraph:

→ *Breadth first search* (hereinafter – BFS) – starts from the selected vertex and explores all its neighbors within one transition distance, and then visits all neighbors within two transitions, etc. cuGraph takes the graph and the starting vertex as parameters, and returns a DataFrame with paths from the starting vertex to all others. [1]

This algorithm is more suitable for a high-density graph than for a disjoint graph, because each vertex will have significantly more neighbors. Also the original graph is connected, this condition is enough to use BFS. The density of a graph for an oriented graph is determined by the formula:

$$D = \frac{R}{N(N-1)},$$

where N – the number of vertices, R – the number of edges and $D \in [0; 1]$. [3]

Consequently, the density index for the original graph is equal:

$$D = \frac{7831764}{1840944 * (1840944 - 1)} \approx 2.311 * 10^{-6}.$$

→ *PageRank* (Page ranking, hereafter – PR) – used to measure the relative importance of elements in a graph by creating a score based on the spread of influence between nodes. It is based on the assumption that important nodes are linked from other important nodes. A node that is referenced by many other nodes with a high PR score itself gets a high ranking. The algorithm has complexity $O(|V| + |E|)$, where V – the number of nodes, E – the number of edges. The cuGraph takes as parameters a graph, and returns a DataFrame with all nodes and their PR, otherwise «importance». [5]

Optimized algorithm:

1. Source data filtering – not directly related to the problem, but it is very important for the correct operation of the algorithm. Since the data before processing can be very different, we take the complexity of the step to be $O(n)$.

2. Creation of transpose graph – $G \Rightarrow G^T$, where G – original graph and G^T – transpose graph. Transposed graph is a graph with the same set of edges and vertices as the original one, but with opposite direction of edges. Complexity depends on the size of input graph, so it is equal to $O(n)$.

3. Find a list of «large/important» vertices using PR algorithm, and remove all with the lowest score. The complexity will be $O(\text{filtering}[\min(\text{pagerank}(G))])$, where $\text{pagerank}(G)$ – the list of important vertices, G – the original graph. Filtering and maximal value have complexity $O(n)$, while PR has complexity $O(n + m)$, where n – number of vertices, m – number of edges, hence:

$$O(n + n + n + m) \Rightarrow O(3n + m) \xrightarrow{\text{discard const}} O(n + m)$$

4. Apply BFS to all vertices from the list obtained in item 4, at the same time filtering unreachable vertices. The complexity will be $O(\text{filtering}[\max(\text{BFS}(G, n))])$, where n – the obtained list from item 3 and G – the original graph. Filtering and max have complexity $O(n)$, while the BFS algorithm has complexity $O(nm)$, where n – the number of list items from item 3 and m – the number of edges. Write and transform:

$$O(n + n + nm) \Rightarrow O(2n + nm) \Rightarrow O(n(2 + m)) \xrightarrow{\text{discard const}} O(nm)$$

5. Applying BFS to a transpose graph, with any starting vertex obtained from item 4. In this case the algorithm goes in the opposite direction for the regular graph. Since among vertices with coefficient PR higher than minimal, there must be some that are starting vertices for at least one maximal path, in the transpose graph we can go from vertices that are final in these paths, thereby obtain new ones, if they have branches. The complexity of this step is $O(\text{BFS}(G^T, n))$, where n – the obtained list from item 4, and G^T – the transposed graph. The complexity equals $O(nm)$, where n – the number of elements in the list from item 4 and m – the number of edges.

6. Item 5 may lead to loss of vertices. This can happen if some vertices from the list obtained in item 4 become inaccessible for others. To avoid this, check which vertices of item 4 are inaccessible in the transpose graph, and if there are such vertices, check the maximal path in the graph, and if it coincides with the maximal path in the transpose graph, add it to the result. All intermediate operations here have complexity $O(1)$, hence they are constants and can be omitted. But several elements can be added, but not more than the number of elements in point 4, so the complexity is $O(n)$.

7. Apply BFS to obtained vertices from step 6. We get a DataFrame, which contains the final vertex and predecessors for each initial vertex from item 6. Thus we can return the full path having these values. The complexity will be $O(nm)$, where n – the number of list items from item 6, m – the number of edges.

Add up all the complexities and transform them to get the *final complexity*:

$$\begin{aligned} O(n) + O(n) + O(n + m) + O(n_3m) + O(n_4m) + O(n_4) + O(n_6m) \Rightarrow \\ O(3n + m) + O(n_4) + O(m(n_3 + n_4 + n_6)) \xrightarrow{n_4 < n_6 < n_3} \\ O(n + m + n_3m) \Rightarrow O(n + n_3m), \end{aligned}$$

where n – the number of vertices, m – the number of edges, and n_3 – the number of vertices from item 3 (take this value, because it exceeds the others). So, the algorithm worked for a total of: 4.25 hours.

Inefficient algorithm:

Does not have some processing steps compared to the optimized one. It does not use the transpose matrix and PR algorithm, but simply finds the maximum length for each initial vertex and compares them. Its final complexity is:

$$O(n) + O(nm) + O(n_{res}m) \Rightarrow O(m(n + n_{res})),$$

where n – the number of vertices, m – the number of edges, and n_{res} – the number of vertices obtained by $O(nm)$. This algorithm ran for a total of 87 hours.

It is important to clarify that the values of n_3 and n_{res} , in the optimized and inefficient algorithm, respectively, are roughly equal.

And so, we get that the optimized algorithm managed to get a result ≈ 20 times faster than the inefficient one.

Conclusion:

The algorithm presented in this article is a more efficient way to process very large graphs, it allows to reduce execution time in comparison with simple GPU-based enumeration. With an initial

graph of 1840944 vertices and 7831764 edges, the time was reduced by a factor of ≈ 20 , which for some graphs can cut days off the execution time without losing precision of the results.

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УДК 004.043

BIG DATA FOR DETECTING FAKE NEWS AND MISINFORMATION

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Fake news has become an important topic of research in a variety of disciplines including linguists and computer science. In this paper, we explain how the problem is approached from the perspective of natural language processing, with the goal of building a system to automatically detect misinformation in news. The main challenge in this line of research is collecting quality data, i.e. instances of fake and real news articles on a balanced distribution of topics [1].

The root causes, the spread and the consequences of fake news are all complex issues. One can take multiple approaches and, indeed, individuals, researchers and organizations have undertaken efforts to address the issue.

Education efforts can be enhanced, starting at the school level, with media literacy, and a general education towards empowering a responsible citizenship, raised in civil and democratic values, who is also able to understand the competing pressures of capitalist societies, including the influence of lobby groups, political parties, and the simple financial gain of creating online content that generates advertising revenue for the creator (and of course for the hosting site). We should pause and think for a moment what the internet would have been like had it not taken the route of using advertising as a form of revenue.

An intuitive framing of the fake news problem in NLP would be to ask how we can classify news text into fake and legitimate instances. This applies especially to the case of full text - as opposed to tweets or headlines distributed on social media - because text classification relies mainly on the linguistic characteristics of longer text. Deception detection in text has a broad literature in NLP, and fake news articles can be considered a category of deceptive text [2]. Methods used for text classification vary from classic machine learning algorithms using a set of pre-defined linguistic features to modern neural network models which mainly rely on pre-trained word vectors and embedded representations resulting from processing large amounts of textual data. In this section, we briefly introduce text classification methods used in the domain of deception detection and, in particular, in fake news detection.

In order to perform automatic classification of news texts, modern NLP and machine learning methods require large amounts of training data. More work in this regard is certainly needed, and we encourage the community to organize and contribute their own datasets, so that we can address this problem in a collaborative fashion.

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MODELING OF HEAT TRANSFER AND STRESSES DURING LASER WELDING USING THE FENICS PACKAGE

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This paper demonstrates the solution of the non-stationary thermoelasticity problem based on finite element modeling in the FEniCS software package, which are Python bindings for the Dolfin solver. The results of calculations of heat transfer and stresses for a simplified model of a weld during laser processing have been simulated.

Keywords:

FEA, thermoelasticity, FEniCS, Python, laser welding, mathematical modeling.

Additive manufacturing (AP), commonly known as 3D printing, is a family of new technologies for manufacturing parts in which a material is applied layer by layer to create objects based on 3D model data. Nowadays, AP methods have been increasingly used in many industries, such as aerospace and biomedical, as they make it possible to produce complex functional components with high accuracy, reduce waste, minimize assembly processes and reduce tooling costs.

The requirements for large-scale metal components, especially in the construction industry, require the connection of smaller, individually manufactured additive parts together. Conventional welding technologies, such as gas tungsten arc welding, are widely used in the industry for the mechanical connection of small metal parts of traditional production. Laser welding is an alternative process of mechanical connection, which leads to narrowing of fields and zones of thermal influence, reduction of warping and reduction of residual stresses compared to traditional welding methods.

Mathematical modeling can be used to analyze the weld and to correct and optimize the laser welding process.

Modeling thermoelasticity is the first step in the implementation of simulation of the phenomenon under study, which is the purpose of this work. The necessary calculations are carried out on the FEniCS computing platform [1], the advantages of which are free access, the availability of open source code, Python/C++ interfaces, as well as a database of original training material.

The main algorithm of the solution is conditionally divided into two stages:

1. calculation of thermal conductivity
2. calculation of thermoelasticity.

At each stage, it is necessary to consistently bring the governing equations from a strict form to a weak one, since the solver accepts equations only in canonical form as input:

$$a(u, w) = L(w),$$

1)

where a is a bilinear form, L is a linear form, u is the desired function, and w is a scalar test function. Obtaining a weak form consists in sequentially multiplying a differential equation in strict form by a test function and integrating over the volume of the computational domain.

Basic equations of the first block are as follows:

$$\rho c_p \frac{\partial T}{\partial t} = -(\nabla q) + Q, \quad q = -k \nabla T, \quad (2)$$

where T is temperature (K), k is the coefficient of thermal conductivity (W/m·K), c_p – specific heat (J/kg·K) " ρ " is the density of material (kg/m³), q is heat flux (W/m), and Q is the volumetric heat source (W/m³).

The heat conduction equation in weak form discretization in time by a finite difference method is as follows:

$$\int_{\Omega} w \cdot \left(\frac{T - T_n}{dt} \right) d\Omega + \int_{\Omega} k (\nabla w \cdot \nabla T) d\Omega = \int_{\Omega} w \cdot Q d\Omega, \quad (3)$$

where T_n is the temperature at the previous time step (K), Ω is the volume element, and w is the test function.

The resulting equation is solved by the finite element method [2].

The main equations of the second block are as follows:

$$\begin{aligned} \operatorname{div} \sigma &= 0, \\ \sigma &= \lambda \vartheta I + 2\mu \varepsilon^{el}, \quad \varepsilon = \varepsilon^{el} + \varepsilon^{th}, \\ \varepsilon &= \frac{1}{2} \cdot (\nabla u + (\nabla u)^T), \\ \varepsilon^{th} &= [(3\lambda + 2\mu)\alpha(T - T_{ref})]I, \end{aligned} \quad (4)$$

where λ is the first Lamé coefficient, μ is the second Lamé coefficient, ε^{el} is the linear tensor of elastic deformation, $\vartheta = \operatorname{tr}(\varepsilon^{el})$ is the first invariant of the linear tensor of elastic deformation (volumetric expansion in linear approximation), I is the unit diagonal matrix, α is the coefficient of thermal expansion (K⁻¹),

T_{ref} is the reference temperature at which the material has its normal volume (K).

The following is the weak form of the elasticity equation (Hooke):

$$\int_{\Omega} \sigma : \varepsilon d\Omega = \int_{\Omega} F \cdot v d(\partial\Omega), \quad (5)$$

where F is the external force (in the case under consideration, it takes zero value, since only the influence of temperature on deformations is taken into account) (H), and v is the vector test function.

To solve the control equations of the two blocks, separate functional spaces are created, as well as the spaces of basic functions, since the solution occurs almost independently, apart from the fact that the temperature field already calculated at the previous stage is used to calculate the full strain tensor, taking into account both elastic and thermal ones.

The temperature distribution in the heating spot forms a Gaussian profile from time to time to simulate the switching on and off of the laser, which can be analytically represented as follows, taking into account spatial constraints:

$$T = \begin{cases} (x - x_0)^2 + (y - y_0)^2 \leq r^2: & T_{peak} = T_0 + (T_{max} - T_0) \cdot e^{-\left(\frac{t-t_0}{dt}\right)^2}, \\ (x - x_0)^2 + (y - y_0)^2 > r^2: & T_0 \end{cases}, \quad (6)$$

where T_{peak} is the peak temperature (in the laser spot) (K), T_0 is the initial temperature, T_{max} is the maximum temperature (in this case at $t_0 = 5$ s), dt is the time step (s), r is the radius of the heating spot (m), and x_0 , y_0 are the coordinates of the center of the spot.

The simulated material is 316L stainless steel.

Modeling of thermoelasticity for a welded joint in a set of software components FEniCS [3] gave the following results (Fig.1) depending on time:

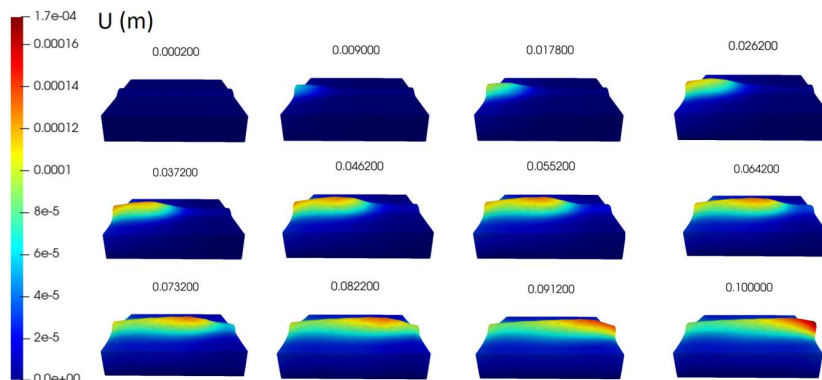


Fig. 1. Displacement field under laser heating with a power of 2 kW, expanded in frames by time in seconds. The offsets are visually scaled by 5 times.

The displacements fully correspond to the propagation of the thermal front along the straight trajectory of the laser beam.

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УДК 66

COMPOSITE MATERIALS WITH THERMAL STABILITY AT HIGH TEMPERATURES

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Scientific progress does not stand still, and in this regard, metallic materials are gradually giving way to composites. These are complex materials consisting of 2 or more components (discrete elements and their connecting matrix) and possessing specific properties different from the total properties of their constituents [3].

The research considers components of composite materials and the composites themselves with a maximum short-term operating temperature of more than 1000°C. These materials are to be considered in more details.

SiO₂-based fibres are available, depending on their content: high silica fibres and quartz fibres (95% and 99.95% silica, respectively). They are characterized by their high strength and flexibility (compared to glass fibres), as well as resistance to temperature. The main characteristics of quartz fibers at 22 °C are shown in Table 1.

Table 1

Material	ρ , кг/м ³	σ_b^+ , МПа	E ⁺ , ГПа
Quartz fiber	2200	6000	69-74

High silicates do not melt or evaporate at temperatures up to 1650°C. At temperatures around 980°C these materials transform into a crystalline form, which is accompanied by an increase in their rigidity while maintaining their physical and insulating properties [3].

One of the most temperature-resistant materials are carbon-carbon composites, which are graphite-like structures reinforced with carbon fibers. Due to their low density (1.5-2.0 g / cm³) they have significant advantages in specific strength compared to other heat-resistant materials [1]. Carbon-carbon materials retain their performance up to 2500-2800°C in an inert environment or in vacuum [5]. The characteristics of this material are shown in Table 2.

FSUE "VIAM" has developed continuous polycrystalline fibers based on the Al₂O₃ – SiO₂ system. Fibers of this composition have an average strength of 1500 MPa. The modulus of elasticity of such fibers is 187–210 GPa, and the application temperature reaches 1700 °C. These characteristics make it possible to use these fibers for flexible thermal insulation materials. The phase composition of the fibers is a mixture of mullite and high-temperature phases of aluminum oxide [2].

Table 2

Frame type	2D	3D	4D
Density, kg/m ³	1,88	1,91	1,91
Tensile strength, MPa	216,6	113,0	110,0
Elastic modulus, GPa	102,8	52,5	50,0
Compressive strength, MPa	108,6	145,0	140,0
Thermal conductivity coefficient, W/m*k	36,4	61,0	54,0

In addition to the components listed above, there are a number of off-the-shelf composite materials capable of operating at high temperatures. These materials were invented by the All-Russian Research Institute of Aviation Materials in accordance with the "Strategic directions for the development of materials and technologies for their processing for the period up to 2030". Such composite materials include:

Gelarm is a multifunctional high-temperature glass-ceramic material based on discrete and / or dispersed reinforcing fillers and a silicate gel matrix. Working temperature of the material is up to 1650 °C; density - no more than 1.5 g/cm³; compressive strength 15-37 MPa. The material is intended for thermal protection [4].

VMK-3 is a "fiber-free" structural ceramic composite material of the SiC/SiC type, which is efficient at temperatures up to 1650 °C in an oxidizing environment, which is characterized by ultra-high thermal stability.

Nanostructured ceramic composite material (NCCM) is a crack-resistant (quasi-plastic) high-temperature carbon-ceramic composite material for the manufacture of heat-loaded units and parts of aircraft engines [6].

VMK-5, VMK-6 – materials based on discrete aluminum oxide fibers. High operating temperatures and dielectric characteristics allow to use these materials for manufacturing radio-transparent radomes for missiles, orientation device windows, elements of the leading edges of the wings of rocket and space technology and hypersonic aircraft, heat-shielding elements of low-inertia thermal units, heat insulation of furnaces [6].

Thus, at this stage of development, the Russian Federation is making great progress in the study of composite materials, various polymers capable of operating at ultra-high temperatures.

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УДК 66

CERAMIC POWDERS AND THEIR APPLICATIONS IN THE MODERN WORLD

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Powder technology currently plays an important role in science and engineering. They form the basis of all kinds of modern technologies: from the processing of various materials, powder metallurgy to additive technologies and gas-thermal spraying of protective coatings.

Powder technology is a collective name for a range of technological processes and operations for obtaining powders by various methods. In powder technologies, great attention is paid to particle sizing and particle shape determination, as well as to the properties of powders which determine their application area. The subject of study and use in powder technologies are the regularities of powder production processes as well as the effect on the physical and mechanical properties of parts produced from powders. [1].

Ceramic powders are now one of the most sought-after powders in the aerospace industry. This is due to their high thermal and mechanical properties. However, in many cases, despite the high functional properties of powders and ceramics in general, it is advisable, without changing the basic composition of the powder, to introduce a small amount of a certain additive in order to change its basic properties radically. This principle is called modification. Ceramic powders are produced both by conventional methods - solid-phase sintering of solids, carbothermal synthesis, self-propagating high-temperature, plasma-chemical and solution synthesis, dissociation of complex compounds and electrolysis [2]. The article considers technologies for producing ceramic powders of different composition and study their possible applications.

In a patent work "Method for producing ceramic composite material powder" [3] a powder of a ceramic composite material mullite-zirconium oxide is obtained. For this purpose, hydrolysed tetraethoxysilane is first mixed with aluminium chloride to produce a mullite mixture. Then tetragonal zirconium oxide is added to this mixture and gelling is carried out by treatment with ammonia (NH₄OH). This is followed by drying of the workpiece, followed by powdering and heat treatment. This material is used to manufacture chemically resistant high-temperature products.

For quite a long time in both aviation and industry, chrome-based aluminium-ceramic compositions were widely used as coatings which were characterised by high corrosion resistance and heat resistance. However, it was later found that hexavalent chromium Cr (VI) of aluminium-ceramic coatings was environmentally hazardous and had to be replaced. Research "Chromium-free ceramic compositions based on silicate" [4] has succeeded in creating chromium-free silicate-based ceramic compositions. The binder is a lithium-doped potassium silicate in combination with aluminum powder. This composition can be used for protective coating of various solid substrates made from ferrous alloys, nickel and nickel-cobalt alloys and other metal and non-metallic heat-resistant surfaces. The coating obtained in this patent is characterized by high corrosion and heat resistance, retained adhesion and flexibility. The composition can be applied to the substrate by any conventional methods known in the art such as spraying, brushing, dipping.

The article "Obtaining strong ceramics of the $ZrO_2 - Y_2O_3$ system from powders synthesized by the combustion of nitrates" [5] considers a method for obtaining a ceramic material of the $ZrO_2 - Y_2O_3$ system, which has a high strength. For this purpose, a powder based on ZrO_2 stabilized with Y_2O_3 was synthesized by the combustion of nitrates (using combustion reactions in the interaction of nitric acid solutions of metals (oxidizing agent) with organic additives (reducing agent) during heating at 100 - 300 ° C.). Before shaping, the powders were mechanically activated in a mill with zirconium dioxide balls. Using the isotactic pressing method, samples were obtained, which were then fired at 1350 ° C. After firing, the linear shrinkage of the specimens was 28 - 33%, the average grain size of the ceramics was about 0.5 μm , and the ultimate strength in bending was 700 - 800 MPa.

In article "Powder technology" [1], volumetric modification of crystalline oxide powders of complex composition was performed. For this purpose, the modifying agent was introduced into the spatial network of the crystal with the formation of solid solutions. In the preparation of sols, hydrolyzed ethyl silicate and the corresponding nitrates were used. During the synthesis of powders of forsterite $2MgO \cdot SiO_2$ and spinel $MgO \cdot Al_2O_3$, their structure was doped with Cr^{3+} , Y^{3+} , and Zr^{4+} ions. As a result, it was found that forsterite doped with Zr^{4+} ions has the highest value of bulk conductivity σ (almost 10 times more than forsterite doped with Cr^{3+}). The grain boundary resistance is almost identical in all three cases. In the study of dielectric losses, three situations were obtained. At frequencies of <10 kHz, the most intense $\tan \delta$ peak is for forsterite doped with Zr^{4+} ions (due to the connection between dielectric losses and conduction relaxation at low frequencies). At a frequency of ≈ 20 kHz, a local peak appears for all samples. In the frequency range 100 kHz - 1 MHz, the highest $\tan \delta$ for forsterite ceramics doped with Y^{3+} .

Thus, by using various methods of modifying ceramic powders, their basic functional properties can be significantly improved and their areas of application can be expanded. When choosing a modification method it is important to consider the degree of crystallinity of the powder, the depth of modification as well as the required properties.

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УДК 007.52

MOBILE ROBOTICS AS A METHOD OF LEARNING PROGRAMMING AND ALGORITHMIZATION***Fatkullina L.¹, Evdokimova T.²***

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This article discusses the possibility of introducing mobile robotics training into the educational program by means of algorithmization and programming, and also compares teaching methods in C / C ++, LabVIEW and using Robotrack equipment.

For many years, we have been surrounded by a variety of gadgets and electronic devices that are upgraded every day. Thanks to the rapid development of electronics, we have a large number of simple developments that even small children can cope with, so robotics is one of the most important, relevant and demanded field of science and technology.

Currently in Russia there is an acute problem of a shortage of qualified engineers in the field of IT technologies.

To solve this problem, it is necessary to introduce programming, algorithmization, electronics with elements of robotics into the disciplines of the curriculum from the elementary grades, which make it possible to interest students, make the learning process more fun, visual and interesting. Also, the use of various sensors makes it possible to solve a specific problem in a variety of ways.

The main problem of classical teaching programming is that in practice, numerical problems are posed that are difficult to apply in reality.

One more important problem should be noted. The modern education system does not provide for a section of mobile robotic systems in the discipline of informatics, or it is touched upon superficially. Also, the problem of classical teaching programming is that in practice, numerical problems are posed that are difficult to apply in reality. However, it is solved through additional education, developing outside the walls of the educational institution.

To compare the methods of teaching programming, consider the classical method of learning in the C ++ language, graphical programming in the LabVIEW language, and programming using equipment.

To implement programs with equipment, a robot based on the Robotrack designer was taken as a basis, the controller of which is trackduino. The heart of the multifunctional trackduino is the Atmega2560 microcontroller. It has everything you need to implement various robotic projects: motor drivers, information and measurement equipment, power supply system, power supply to all external ports [1].

The created robot is equipped with actuators and various sensors. The ability to use sensors optimizes the functions of the robot much more than the algorithms of computers.

On the example of the assembled robot in Tables 1, 2, 3, 4, linear, cyclic and branching algorithms are considered, for comparison they are implemented in other programming languages, and program solutions are shown.

Table 1

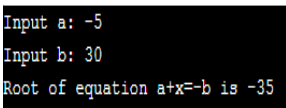
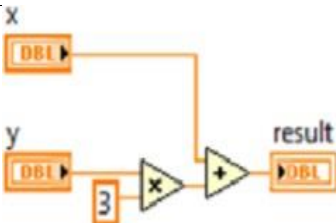
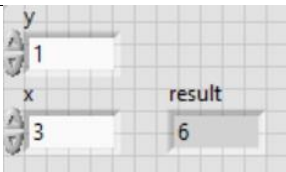
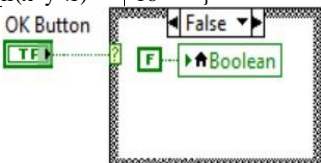
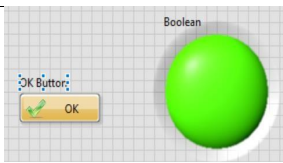
Table 1			
Linear algorithm			
C/C++	<pre>1 using namespace std; 2 int main() 3 { 4 double a, b; 5 cout << "Input a: "; cin >> a; 6 cout << "Input b: "; cin >> b; 7 double x = a-b; 8 cout << "Root of equation a+x=-b is " << x << endl; 9 return 0; 10 }</pre>		
LabVIEW			
MicroPython and Arduino C	<pre>1 void setup() 2 { 3 } 4 void loop() 5 { 6 startMotor (1,40); 7 startMotor(2,40); 8 delay(2000); 9 stopMotor(1); 10 stopMotor(2); 11 }</pre>	The result of this program will be the movement of the robot.	

Table 2 shows examples of the execution of the branching type algorithm in commonly used programming languages.

Table 2

Forking algorithm			
C/C++	<pre>1 int main() 2 { 3 double x, y, 4 Z; 5 cout<<"x="; 6 cin>>x; 7 cout<<"y="; 8 cin>>y; 9 if(x*y<1)</pre>	<pre>9 { 10 Z=x+y; 11 } 12 else { Z=x-y; 13 } 14 cout<<"Z=" 15 <<Z<<endl; 16 return 0; 17 }</pre>	<div>При $xy<1$</div> <div>$x=-3$ $y=5$ $z=2$</div> <div>При $xy>1$</div> <div>$x=5$ $y=15$ $z=-10$</div>
LabVIEW			

Continuation of table 2

Forking algorithm			
MicroPython and Arduino C	<pre> 1 void setup() 2 { 3 pinMode(IN1, INPUT);4 } void loop() 5 { 6 if (buttonRead(IN1)) 7{ 8 startMotor(1, 40); 9 startMotor(2, 40); </pre>	<pre> 10 } 11 else 11 { 12 stopMotor(1); 13 stopMotor(2); 15 } 17 } 18 voidsetup() 19 } </pre>	When the button is pressed, the robot will move in a straight line.

Table 3 shows the implementation of the looping algorithm using the for statement.

Table 3

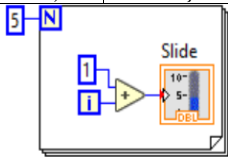
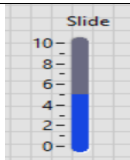
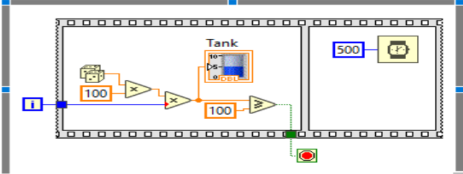
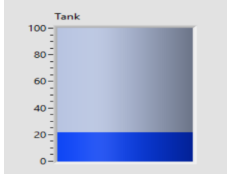
Loop algorithm with for			
C/C++	<pre> 1 int main(int argc, char* argv[]) 2 { 3 for (int counter = 8; counter <= 15; counter ++) </pre>	<pre> 4 cout << " " << counter; 5 cout << endl; 6 system("pause"); 7 return 0; 8 } </pre>	8 9 10 11 12 13 14 15
LabVIEW			
MicroPython and Arduino C	<pre> 1void setup() 2{ pinMode(OUT1,OUTPUT); 3} 4void loop() 5{ </pre>	<pre> 6 for (_ABVAR_1_a=1; _ABVAR_1_a<= (5); ++_ABVAR_1_a) 7 { led (OUT1 , HIGH); 8 } 9 } </pre>	LED flashes 5 times

Table 4 shows examples of executing the looping algorithm using the while operator.

Table 4

Loop algorithm with while			
C/C++	<pre> 1 cout << count <<"- speed = " <<speed << endl; 2 count++; 3 } 4 system("pause"); 5 return 0; 6 } </pre>	<pre> 5-speed = 17 6-speed = 27 7-speed = 37 8-speed = 47 9-speed = 57 10-speed = 67 11-speed = 77 </pre>	
LabVIEW			

Continuation of table 4

Loop algorithm with while			
MicroPython and Arduino C	1	void loop()	The robot reads the values from an ultrasonic or infrared sensor and, provided that the distance is more than 15 cm, it continues to move.
	2	{	
	3	while (((distanceCM(IN1)) > (15	
)))	
	5	{startMotor(2, 100);	
	6	startMotor(1, 100); }	
	7	}	

Having considered examples of writing programs in widely used programming languages, by means of analysis it is possible to highlight the advantages and disadvantages of methods of teaching programming and algorithmization without equipment and with equipment.

First, let's highlight the benefits of two teaching methods.

Learning without equipment: structured code, application of logical thinking, objective-oriented programming.

Learning with equipment: simple installation, visual teaching, the use of logical thinking, a variety of sensors, the creation of projects (movement along a line, a maze, a bowling alley, etc.), stimulating student motivation to gain knowledge, a non-standard approach to solving problems.

Let's note the shortcomings in conducting practical exercises.

Training without equipment: a sufficient number of design kits is required, the sensor operation system, microelectronic elements are in the case, the assembly of robots is far from reality used in production.

Learning with equipment: does not correspond to the realities of today, a large amount of time to explain and understand the material, the use of programs only for algorithmic problem solving, complex syntax and verbose codes.

Comparisons of commonly used hands-on training programs, C / C ++ and LabVIEW, and also, compared the implementation of the program code using Robotrack equipment, helps to draw the following conclusions. It is necessary to introduce a section on the development of a mobile robotic platform into the computer science course, where attention is focused on developing the skills of algorithms, loops and programming.

Using construction kits in the educational program will instill in students an interest in robotics and, thus, the shortage of qualified engineering personnel, especially in the field of electronics and IT technologies, will be eliminated.

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УДК 004.032.26

FORECASTING THE PARAMETERS OF EVERYDAY PROCESSES USING A NEURAL NETWORK

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Fast-paced processes are processes with a frequency of change measured in fractions of a second. [1] These processes include combustion and explosion of high-energy substances. Each such process is characterized by certain parameters. These parameters are either calculated mathematically or found experimentally. Such experiments can be expensive and, in some cases,

even life-threatening. Therefore, approaches based on computer modeling are of particular importance, which make it possible to analyze and find the parameters of processes based only on their theoretical and computational presentation.

In this work, I predicted the high-explosiveness parameter. High explosiveness is the ability of explosion products of an explosive substance to perform work during expansion, which depends on the heat of the explosion, the volume and composition of the gases released during the explosion. [3]

To solve the forecasting problem, we will use a neural network of the multilayer perceptron type, hereinafter referred to as MLP. The main distinguishing features of MLP are the presence of more than one hidden layer, the use of a nonlinear activation function, usually sigmoidal, the signals arriving at the input are not binary, but are encoded with decimal numbers normalized to the interval (0,1), and the network error is calculated not as a wrong number recognized examples, but as some statistical measure of the discrepancy between the desired and obtained value. [2]

In this work, the neural network was trained and tested on data (over 80 explosives) from the explosive's handbook. [3] The values of the heat of explosion, the volume and composition of gases released during the explosion, the number of atoms of carbon, hydrogen, oxygen and nitrogen, as well as the explosiveness (obtained experimentally) were used as input parameters for training.

The neural network was written in Python using the free PyTorch machine learning framework and consisted of 2 hidden layers. In the first layer there were 10 neurons, and in the second there were 32. Activation function ReLu, the backpropagation algorithm is used for training

At the end of training, this model showed a prediction error of about 16%. The maximum error is 18%. However, for most substances, acceptable results were obtained.

Thus, the results obtained allow us to say that the use of this algorithm for predicting the explosiveness is possible, and with a fairly good error.

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УДК 621.01, 004.942

ANALYSIS OF HYDROELECTRIC POWER PLANT OPERATION AND POSSIBILITY OF ITS CONSTRUCTION

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Abstract: The article discusses the relevance of the proposed hydropower plant, its advantages, as well as the possibility of the construction in the territory of the Republic of Tatarstan.

For today, the construction of hydroelectric power plants (HPPs) and the location of hydropower plants has a detrimental effect on water bodies: from drastic changes in the hydrological regime of the river to serious changes in the existing ecological systems [1]. In addition, the construction of various hydropower plants causes damage to aquatic biological resources, which often leads to disruption of the conditions of natural reproduction of fish. This problem can be solved by reducing the size of constructions and the right choice of location. It is

necessary to look for ways to increase the performance coefficient (efficiency) of devices, as well as ways to reduce large losses of energy of mechanical actuators (levers, turbines, pistons, etc.), which would cause less environmental damage.

Hydropower plant, which was chosen as a prototype, has a different principle of conversion of mechanical energy. Since this unit has a small size compared to most hydroelectric power plants, it will not have a negative impact on the fauna of rivers. Also, the selected HEP is not of a turbine method, which often causes harm to the state of rivers and becomes the cause of deleterious effect on fish, but based on the piezoelectric method of converting water energy into electrical energy, and therefore the harm from its use will be the least.

The main domestic manufacturers producing piezoelectric elements used in various sensors are: NKTB "Piezopribor", Concern "Ocean-Pribor", LLC "Aurora-Elma", JSC Research Institute "ELPA", SPE "TIK" Perm, Research Institute of Physical Measurements, Penza, Central Research Institute of Machine Building, Korolev, LLC "Piezoelectric" Rostov-on-Don, JSC "Vibropribor", LLC "Activ Thermocube", Ekaterinburg, Saint Petersburg.

The main foreign companies producing piezoelectric elements used in various sensors and piezoelectric sensors themselves are Kistler Instrumente AG (Switzerland) and Brüel & Kjær, a subsidiary of British corporation Spectris plc, PCB Piezotronics JNG, Endevco Corporation, DYTRAN, Sanstard Date contrl - (USA), Erich Broza, Rheometron - (Germany), Flopetron, C. F.V. LTD - (France), Merles, Motorola JNG, AVL - (Great Britain), Hans List - (Austria).

Let's consider the basic principles of electricity generation before considering the principle of operation of the selected hydroelectric power plant (HPP).

Electricity generation is the process of obtaining electricity from primary energy sources. One of the characteristics of electricity is that it is not a primary energy, freely present in nature in significant quantities, therefore, it must be produced. The production of electricity usually takes place with the help of generators at industrial plants, which are called power plants.

Today there are the following types of hydroelectric power plants:

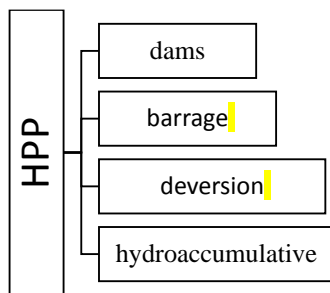


Figure 1. Types of hydropower plants

But all types of the above mentioned HPPs have the following disadvantages:

- construction is possible only in places with large reserves of water energy;
- unregulated water releases from reservoirs lead to the restructuring of unique ecosystems along river beds, so rivers are polluted, fish populations are reduced, nesting places of migratory birds disappear;
- construction of a large dam requires a lot of material and is expensive;
- construction of hydropower plants compared to other energy sources is longer and more expensive;
- large reservoirs and dams cause drying of rivers;
- large dimensions;
- conservative method of transformation of mechanical energy of water into electric energy.

Let's consider the principle of operation of hydropower plant. Hydropower plant (HPP) [2] refers to environmental hydropower systems and can be used to convert wave or current energy in rivers to produce electricity.

The hydropower plant [patent number 183125] is a water storage tank 1 (Fig. 2). It has a sloping pressure water conduit 2, in which the flow of water into the slotted guiding device 3 is organized. Depending on the amount of water in the reservoir 1 and its size, the water conduit 2 may have several narrowing channels in which, due to narrowing, the speed of water flow increases. After the acceleration node, a hydrodynamic radiator 4 of plate type, which is fixed in the bracket 7 (Fig. 2), is installed. After the radiation zone on the walls of the water duct 2, piezoelectric elements 5, protected from the action of the fluid by an elastic impermeable shell 6, from which electric potentials are withdrawn, are installed. To protect the walls of the water duct 2 from cavitation damage, the entire inner surface, together with the piezoelements 5, is covered with an elastic protective shell, through which the pressure is transferred to the piezoelements 5 (Fig. 3).

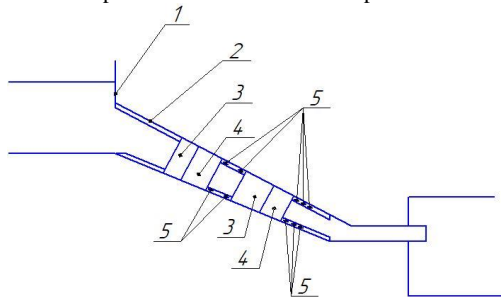


Figure 2: Schematic diagram of a hydraulic unit with piezoelectric transducers

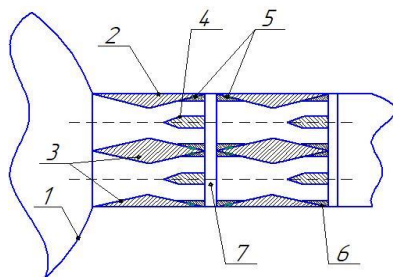


Figure 3: Top view of the water line of a hydro unit with piezoelectric transducers

The Republic of Tatarstan has a large number of different reservoirs, that allows to choose the most advantageous location for the project.

One of these places is Kuibyshev reservoir. About 100 rivers (Vyatka, Mesha, Sviyaga, Kazanka and many others) flow into it, including Kama - the first in size after the Volga and the most abundant river of the Volga basin. From April to October north, west and northeast winds prevail in Kuibyshev reservoir with an average speed of 3-5 m/s (in autumn - up to 4-6 m/s). Wave height is usually less than 0.5-0.75 m, wave height of 2.5-3 m is annually registered on separate enlarged parts of water area (maximum wave height - 3.7 m is registered near Kamskoe Ustje village) [3]. That will allow to create necessary pressure differences and wave velocities in the proposed installation. At correct selection of a place there will be an opportunity of realization of tens-hundred kW of energy for a season by one installation. It is suggested to install sequentially about 6-8 devices for generation and accumulation of more electric power.

Formation of a stable ice cover on Kuibyshev reservoir occurs at the end of November - beginning of December, therefore, it will be necessary to "take out" installations in winter period until the breaking up of ice - in the middle of April (early - first days of April, later - the end of April), which is a drawback of hydropower installation.

Initial cost of the installation itself and its implementation assumes the sum of approximately 800 thousand rubles for the cascade of 6-8 installations. This is necessary, as noted above, to generate the required amount of energy for the "consumer". Payback is approximately 3-4 years from the day of implementation.

More detailed analysis of disadvantages and advantages will be obtained during production of the experimental model, which will allow to eliminate deficiencies even before the mass introduction of the proposed hydroelectric power plant with piezo generators.

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УДК 621.01

ERROR ANALYSIS OF THE PIEZOELECTRIC GENERATOR OF A HYDROPOWER PLANT

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Abstract: the article deals with the calculations concerning the error of the piezo generators, or to be more precise, the piezo elements used in the hydropower plant.

The purpose of this article is to justify the requirements to the systematic and random components of the errors of the primary information sensors, elements of the conversion channel.

The solution of the problem of substantiation of requirements to metrological characteristics of functional elements of the circuit at the stage of systematic design is the equation of errors, linking the resulting error of each of the channels of the designed system with the errors of the functional elements included in it [1].

Piezo-sensors are widely used to measure various values. Their informativity is characterized by dynamic and frequency ranges, basic error and additional errors due to the impact of influencing factors [2]. The upper and lower limits of the dynamic range of piezoelectric sensors are determined by the strength or nonlinearity of the properties of the structural elements (piezomaterial, membrane, etc.) and amplifier noises, respectively [3]. The frequency range is limited from below with the time constant of the electric circuits and from above, with an error of 5%, that is one fifth of the resonant frequency of the mechanical system [4].

It should be noted that any sensor or a unified series of sensors, as a rule, is created to solve a particular engineering problem and must have a set of technical characteristics corresponding to the controlled process or object. And, if at least one of the sensor parameters, such as operating

temperature limit, or acceptable vibration levels, or corrosion resistance do not meet the requirements, then the product becomes unsuitable for use in the given conditions.

However, it is difficult to fully analyze a maximum number of PDs for a number of reasons. Firstly, suppliers do not always indicate the full volume of characteristics in their catalogs and specifications, secondly, the same technical characteristics are formulated differently: for example, foreign companies, when calibrating a static transducer of variable pressures, do not indicate the limit of basic allowable error but only its components (non-linearity, hysteresis), do not indicate measurement error in the operating frequency range, but give only the resonance frequency. Additional errors for temperature changes are given as the most probable but not the maximum allowable ones. As a result when comparing metrological characteristics of devices of domestic and foreign firms, in which measurement errors, declared by the manufacturer, are involved with one or another weight, it is difficult to get an objective picture [5].

The analysis of the obtained error data shows that, despite the achieved rather high technical level of both domestic and foreign piezoelectric sensors, there are significant perspectives for further improvement of their accuracy characteristics.

In the designed device the sources of errors can be:

- parasitic Electro Motive Force (EMF);
- instability of cable capacitance;
- cable vibration;
- temperature change of the piezoelectric element;
- imperfection of piezoelectric materials.

Parasitic EMF can be induced in the measuring circuit by external electromagnetic fields. This variable EMF creates an error. To protect against fields, the measuring circuit is shielded and the sensor is connected to the secondary transducer with a shielded cable. However, the instability of the cable capacitance due to bending introduces an error.

When the cable bends, it can delaminate. Electrical charges are formed on the delaminated surfaces due to friction. Movement of the charged surfaces under the action of cable vibration leads to the appearance of some variable EMF. The error caused by cable vibration can be significantly reduced by using special anti-vibration cables. Measurement circuit instability can be caused by increasing humidity or an abrupt change in its temperature.

Changing the temperature of the piezoelectric element also causes changes in its piezoelectric modulus and sensitivity.

Transducer error can also be caused by imperfections in piezoelectric materials: hysteresis of the characteristic and its nonlinearity. If forces acting in the transducer are perpendicular to the piezoelectric sensitivity axis, an error due to the transverse piezo effect is possible.

Let us solve the problem of error analysis in the following sequence:

I. Taking into account the introduction of correction of basic systematic errors, let's make an equation for determining the pressure of the working fluid in the Hydro Power Plant (HPP) system:

$$y = f(p), \quad (1)$$

where p is the measured input signal.

Using a linear approximation, the influence of measurement, normalization and digitization errors of input signals p , the influence of information processing error on the total error of the piezo generator channel are determined.

II. For the systematic components of these errors, the total error of the system can be represented in the form [1]:

$$\Delta y = \sum \frac{\partial f}{\partial p_i} \Delta p + \Delta_{proc}, \quad (2)$$

where Δp – is the systematic error of measurement, normalization and digitization of the input signal, Δ_{proc} – is the systematic error of the information processing and representation device in the required form; $\frac{\partial f}{\partial p_i}$ – is in general a dimensional function characterizing the effect of the

corresponding error Δp on the total error of the working fluid pressure measuring channel.

III. For the random error components, a similar equation for the total random error of the system will have [1]:

$$\sigma_{\Delta y}^2 = \sum \left(\frac{\partial f}{\partial p_i} \right)^2 \sigma_{\Delta p_i}^2 + \sigma_{proc}^2, \quad (3)$$

where $\sigma_{\Delta y}$, $\sigma_{\Delta p_i}$, σ_{06p} – RMS values of the corresponding random errors.

Initial data for the sound pressure measurement channel:

- Pressure measuring range, p 0...40 kPa
- Maximum output signal value, U_{out}^A 1,6 V
- Output voltage value, y 12 V
- Basic error of measurement, γ_0 0,5 %

1. Let's determine the coefficient of influence ψ_i reduced to the output errors of the functional elements on the resulting error of the channel, by formula [1]:

$$\psi_i = \frac{1}{Q_i}, \quad (4)$$

where Q_i – differential sensitivity of functional elements.

In order to calculate the influence coefficient ψ_i of the functional elements, it is necessary to determine the differential sensitivities of the functional elements Q_i included in the system by the formula [1]:

$$Q_i = \frac{y}{x}, \quad (5)$$

where y is the output value of the functional element; x is the input value of the functional element.

Let's calculate the differential sensitivity of the piezogenerator:

$$Q_{\Pi} = \frac{U_{out}^d}{p_{max}} = \frac{1,2 V}{40 kPa} = 0,03 \frac{V}{kPa}. \quad (6)$$

Let's calculate the coefficient of influence of the piezogenerator error reduced to the output on the resulting channel error:

$$\psi_{PG} = \frac{1}{Q_{PG}} = \frac{1}{0,003 \frac{V}{kPa}} = 333,33 \frac{kPa}{V}. \quad (7)$$

2. Let's determine the admissible values of the systematic Δy_i^{add} and random $\sigma_{\Delta y}^{add}$ components of the error of functional elements by the method of successive approximation. We assume that the contribution of all elements in the magnitude of the corresponding resultant error is the same and the allowable values of systematic and random components of the error of functional elements, we determine by the following formulas:

$$\Delta y_i^{add} \leq \frac{\Delta x_i^{add}}{N \psi_i}, \quad (8)$$

where $\Delta x_i^{доп}$ – permissible resultant systematic error of the i -th channel, determined by the formula:

$$\Delta x_i^{add} = \gamma_0 \frac{p_{max}}{100 \%}; \quad (9)$$

$N = n + 1$, where n – the number of functional elements in the measuring channel ($n = 5$).

$$\sigma_{\Delta y_i}^{add} \leq \frac{\sigma_{\Delta x_i}^{add}}{\sqrt{N} \psi_i}, \quad (10)$$

where $\sigma_{\Delta x_i}^{add}$ – permissible resultant random error of the i -th channel, determined by the formula:

$$\sigma_{\Delta x_i}^{доп} \leq \frac{\Delta x_i^{add}}{3}. \quad (11)$$

Let's calculate the value of the permissible resultant systematic and random component of the error of the pressure measuring channel:

$$\Delta x^{add} = \frac{0,5 \% \cdot 40 kPa}{100 \%} = 0,2 kPa, \quad \sigma_{\Delta x}^{add} = \frac{0,2 kPa}{3} = 0,067 kPa.$$

Let's calculate the permissible values of the systematic and random component of the error introduced by the piezo generator:

$$\Delta y_d^{add} = \frac{\Delta x^{add}}{N\psi_d} = \frac{0,2 \text{ kPa}}{6 \cdot 333,33 \frac{\text{kPa}}{V}} = 1 \cdot 10^{-5} \text{ V}, \quad (12)$$

$$\sigma_{\Delta y_d}^{add} = \frac{\sigma_{\Delta x_d}^{add}}{\sqrt{N}\psi_d} = \frac{0,067 \text{ kPa}}{\sqrt{6} \cdot 333,33 \frac{\text{kPa}}{V}} = 8,205 \cdot 10^{-5} \text{ V}. \quad (13)$$

The metrological requirements are within the permissible limits.

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УДК 665.642.2

IMPROVEMENT OF SOLUTIONS FOR OIL RESIDUES VISBRACKING UNITS

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Oil and gas play a major role in providing energy these days. The fuel purchased from them is used to start the engines of land, air and water transport, thermal power plants.

Considering the primary oil refining scale, Russia comes the second after the United States. However, in terms of visbreaking (thermdestructive process) power, it lags behind the leading states. The oil refining depth in Russia is about 72%, while in Western Europe - 87%, and in the USA - 95% [1].

Russia's energy strategy for 2025 is to increase oil refining up to 85%.

Deepening oil refining in the Russian Federation will repel from the raw materials presence as a capacity utilization of the processes, due to which the refining intensification and the new technologies development for deep processing of oil residues will occur.

It is quite possible to increase the depth of processing due to the intensified development of the crushing processes of processing heavy hydrocarbon raw materials with the useful fuel extraction and petrochemical products [2]. These processes include catalytic methods and methods for massive hydrocarbon feedstock hydrogenation processing, including fuel oil, tar. The estimates show that in order to acquire the calculated indicators of oil refining, in addition to the auxiliary number of catalytic units construction at the oil refineries of the Russian Federation, it is inevitable, but it is also necessary to increase the thermal processes capacity, such as visbreaking, coking.

In thermal processes, a chemical change in raw materials occurs; catalysts are not used in this case. The visbreaking stage (thermal cracking) is a thermal process that can implicitly lead to a deepening of oil refining. Visbreaking part from primary processing is about 10%, then an order of magnitude more than the other deepening processes share [3].

Visbreaking is carried out in a milder environment than the thermal process of oil refining (cracking), the molecular weight of the raw material is higher, which means the thermal stability is lower, including the easier the oil refining process. The process temperature is in the range of 440–470 °C (sometimes it reaches 500 °C), the pressure is 1.4–2.5 MPa.

The visbreaking capabilities for increasing the light oil products production are limited by the needs for the resulting residue quality. The conversion degree of raw materials in this process is the smallest, light oil products control from tar, as a rule, is not higher than 5–20%, and from fuel oil - 16–22%. At the same time, about 75% of the conditionally unconverted residue comes out, which is used as boiler fuel.

To obtain boiler fuel from tar without upgrading them, a large volume of distillation (distillate) diluents is required. Taking this into account, visbreaking can be considered as a more favorable process for reducing the viscosity, due to which the consumption of diluents is reduced by 20–25% of the mass. An important financial element of the visbreaking process application is considered to be the release of vacuum gas oil and middle distillates, previously used in the commercial fuel oil production, as a diluent to obtain the required viscosity of boiler fuel [4].

If the visbreaking unit is expanded with vacuum columns, then the yield of distillate fractions instantly increases and the yield of the visbreaking residue drops to 50–60% of the mass per raw material. To reduce the yield of the cracked residue, schemes are used in which the visbreaking process is combined with vacuum distillation and thermal cracking. According to the scheme provided, the output of the diesel fraction is expanded to about 23%, and the capacity for cracking - the rest is reduced to 66%.

Depending on the process purpose, they stop at the visbreaking technological scheme. They take into account the schemes for the large amount of boiler fuel production with the gasoline and gas shortest output. The schemes are inherent, due to which the maximum output of diesel fuel is ensured. Several types of visbreaking units operate outside the Russian Federation.

The most accessible method for creating boiler fuel is in a furnace with a reaction chamber. When using a remote soking chamber, the movement of products in the process occurs from the bottom up, as opposed to conventional thermal cracking, in fact increases the presence of the liquid phase in the reaction zone, in accordance with this, leads to a greater degree of thorough transformation of the incoming raw material.

The intricate circuits contain many deep vacuum blocks. The main one is for the raw material evacuation, the minor one is for the evacuation of the cracking residue. As the two vacuum units are turned on, the highest degree of diesel fuel yield is observed, about 30%, and the viscosity of the cracked residue is reduced by 10 times.

Most foreign companies are involved in the assessment of the visbreaking process, such as Shell, Lummus, Kellog, UOP, Foster Wheeler KBR, Chiyoda. The leading research institutes of the Russian Federation are engaged in the visbreaking process technology development. Recently, visbreaking has undergone various changes. The developers presented various visbreaking options.

The main recent visbreaking conclusion is catalytic visbreaking in the presence of steam. This process is called Aquaconversion, in contrast to conventional visbreaking with a large yield of distillate fractions, thus keeping capital costs low. In the furnace, the residual raw materials are heated to the temperature of thermal cracking, taking this into account, the polymerization and condensation reactions are destroyed. This is due to the mild reaction of the radicals generated during the process. Due to the transport of hydrogen from a small amount of water added to the feed in the presence of an active catalyst, a reaction occurs. In the course, a large conversion depth is achieved, during which the asphaltenes do not settle. In addition, the active catalyst is separated in the recovery unit with its subsequent return to the feed line.

The main perspective conversion of visbreaking is the Japanese technology of Toyo Engineering Corporation and Mitsui Chemicals, the use of which allows increasing the conversion of raw materials.

The French Institute of Petroleum, together with the French firms ELF and Total, have come up with anhydrous visbreaking, hydro-visbreaking and catalytic hydro-visbreaking.

Among the Russian ones, the Visbreaking-TERMAKAT unit is distinguished, which guarantees a sufficiently high conversion of fuel oil into gasoline-diesel fractions [5].

There are two main directions of visbreaking development in Russia and abroad.

The first direction is "furnace", or in other words "coil", visbreaking in a furnace with a juice section. In it, a high temperature (480-500 °C) is combined with a short residence time (within 1.5-2 minutes).

The second direction is visbreaking with a portable soker chamber. Its peculiarity is the difference in the supply of raw materials to the reactor.

There are two types:

- visbreaking with an upward flow of raw materials,
- visbreaking with downdraft of raw materials.

A lower temperature (about 430-450 °C) and a longer residence time (about 10-15 minutes) are used to achieve the required conversion.

Visbreaking with a soker chamber has a number of advantages over the "oven"

- capital costs reduction by about 10-15%,
- sufficiently small dimensions of the furnace,
- small dimensions of the equipment used for heat recovery from flue gases,
- low pressure drop in the furnace,
- low fuel consumption,
- relatively large production volumes,
- higher degree of selectivity,
- non-stop operation increases by about 1 year, the system operation time per stream is about 330 days,
- low sensitivity to accidents,
- a small amount of steam from the recovered heat.

All these qualities justify the correct design of visbreaking units with a reaction chamber.

Consequently, the visbreaking process is now conquering the second wave of technological demand. In the past, visbreaking was used exclusively to reduce the viscosity of tar, today it is used to deepen oil refining.

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УДК 54.02

ELASTOMERIC MATERIALS OF HIGH HEAT AND FIRE RESISTIVITY

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Today, the development of the aviation industry dictates the need to create new materials with an increased complex of properties. The trend towards higher operating temperatures in machinery and equipment is leading to the development of materials with high heat resistance. Great attention

is paid to flexible materials that can not only withstand ultra-high temperatures, but also retain their elastic properties. Elastomeric materials are definitely one of these flexible materials.

Elastomeric materials are polymers with highly elastic properties in in their operating range. A rubber or elastomer is any elastic material that can be stretched to many times its initial length [7].

Thermal fire resistance property of polymeric materials and products made from them is determined in technology by characteristics such as flammability, ignition or auto-ignition temperature, rate of burnout and flame spread over the surface, smoke emission during combustion, toxicity of combustion and pyrolysis products [6].

A group of Russian scientists headed by V.F.Kablov has for many years been developing various methods of creating elastomeric materials capable of operating at high temperatures. One of the promising directions for increasing the thermal resistance of such materials is the use of intumescent (pearlite, vermiculite, thermally expandable graphite) and highly dispersed fillers, including highly dispersed silicon carbides, in the composition of elastomeric compositions [1-2]. Scientists investigated vulcanizates based on styrene-butadiene rubber SKMS-30ARKM 15 with a sulfur vulcanizing group, and perlite and microdispersed silicon carbide were used as fillers. When the material was exposed to the open flame of the plasmatron (Fig. 1) a temperature of 2500 °C was generated on the surface. This resulted in the formation of a dense and resistant coke on the surface, which protects the sample from combustion. The plastic shape of the silicon carbide particles makes it possible to create a kind of barrier layer that protects the sample from the effects of flame [5].

In one of the works of V.F. Kablov rubber compounds made according to a standard formulation based on butadiene styrene rubber with a sulphur vulcanising group with partial replacement of technical carbon by zirconium dioxide were studied. As a result, zirconium dioxide was found to not only make the elastomeric material cheaper, but also effectively increase flame resistance [3].

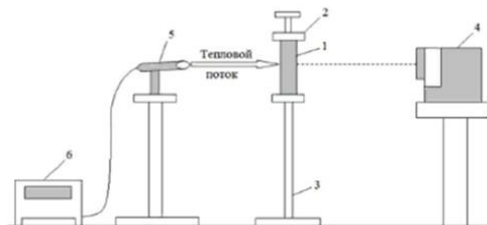


Figure 1 - Schematic diagram of a fire and heat protection appraisal unit characteristics: 1 - sample; 2 - clamp; 3 - tripod; 4 - pyrometer; 5 – plasma torch; 6 - plasma torch power supply

In another work of the scientist, there were obtained samples of EPDM-40 ethylene-propylene diene rubber in comparison with well-known mineral filler - kaolin ($\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$). While testing the characteristics of fire resistance, 2000 °C was created on the surface. The formation of a dense and flame-resistant coke, protecting the samples from combustion, was observed during the study on samples with kaolin fibre [4].

Among elastomeric materials, siloxane rubbers, which are high-molecular-weight organosilicon compounds produced by the polycondensation of silanediols, have great heat resistance [6]. FSUE “VIAM” has created heat-resistant rubber-like materials based on siloxane rubbers. The brands FKS-1, FKS-2 and FKS-4 are widely known, their properties are shown in Table 1.

Table 1 - Properties of Domestic Siloxane Rubber

Properties	Values of material properties of grades		
	FKS-1	FKS-2	FKS-4
Upper temperature limit of serviceability, °C	350	400	450
Conditional tensile strength, MPa (GOST 270-75)	8.8	6.9	7
Elongation at break, % (GOST 270-75)	80	90	90
Shore A hardness, conv. units (GOST 263-75)	70–90	65-80	70-80

Martin Marietta Corp. has developed a number of ultralight thermal protection materials (SLA-220, SLA-561, SLA-741), which are used, in particular, for spacecraft intended for landing on Mars [8]. These materials are made on the basis of organosilicon elastomer filled with silica and phenol-formaldehyde microspheres 0.07-0.2 mm in size. Cork or cork oak bark particles 0.4-0.75 mm in size are added to the material to impart coking ability. Silica or carbon fibres are used to strengthen the materials.

The analysis of the articles showed that at this stage of development there is a great progress in the study of composite materials, various polymers capable of operating at ultrahigh temperatures. New elastomers operating up to 2500°C will be developed in the near future.

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УДК 54.02

MODERN RUBBERS PERFORMED EFFECTIVELY AT LOW TEMPERATURES*Yusupov I.I.*

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Today, the development of the aviation industry requires the creation and application of new materials capable of being used in a wide range of temperatures. In addition, materials must retain their physicochemical, mechanical characteristics when exposed to various aggressive environments. The article considers modern cold-resistant rubbers based on various rubbers, their application and properties.

Frost resistance is the ability to maintain performance at low temperatures [1]. The frost resistance of rubbers is determined by the combined action of two processes, glass transition and crystallization. The peculiarity of low-temperature rubbers in aviation and cosmonautics is combination of cold-resistance with high ozone- and weather-resistance, operation in all-weather conditions, and in some cases the resistance to aggressive environment, such as oils and hydraulic fluids, while ensuring serviceability of products in a wide temperature range of operation [2].

Many scientific institutes in the Russian Federation are engaged in creating and introducing materials with new properties. One of the leading ones is the Federal State Unitary Enterprise "VIAM". It has developed a number of frost-resistant rubbers capable of withstanding not only low temperatures, but also of maintaining resistance to aggressive environments. Let us consider them in more detail.

Rubber based on non-polar rubbers. These rubbers are of limited use due to low weathering and ozone resistance. The most frost-resistant rubber of this category is non-crystallizing rubber SKMS-10. Rubber made of it does not lose its serviceability at temperatures down to -70°C. But it is rather difficult to use SKMS-10 due to unsatisfactory technological properties of the rubber because of its rigidity. Besides SKMS-10 there is a non-crystallizing butadiene styrene rubber (BSR) of solution polymerization of DSSK-18 brand. It also has high frost resistance and does not require thermoplasticization [3].

Propylene oxide rubber (SPOR) is also to be noted, it has a low glass-transition temperature T_c (-74°C), a low tendency to crystallization and a high index of frost resistance by elastic recovery $K_w = 0.63$ (at -50°C) [3].

Rubbers based on fluoroelastomers - fluorocarbon rubbers. Such rubbers include frost-resistant rubbers SKF-260, SKF-260V and SKF-260 MPAN, and also fluoroelastomers 51-1742 and 51-1780, capable of operating at temperatures above -40°C [3]. These rubbers are required for the extreme conditions of aviation and aerospace where high oil and fuel resistance as well as resistance to high pressure are required.

Rubbers based on nitrile butadiene rubbers (NBR). Frost resistance of rubbers based on sulfonate nitrile rubbers (SCN) is determined by the content of acrylic acid nitrile, with the increase of which frost resistance decreases [3]. Such frost-resistant NBRs as SKN and BNKS are produced in Russia. Depending on the content and type of plasticizer the minimum operating temperature is shown in Table 1.

Table 1 - Properties of rubbers

Rubber grade	Temperature range, °C
SKN-18, BNKS-18	(-55;-45)
SKN-26, BNKS-26	(-50;-40)
SKN-40, BNKS-40	(-30;-10)

Rubbers based on ethylene-propylene rubbers (EPDM). Frost resistance of rubbers based on triple rubber (EPDM) is determined by the ongoing processes of microcrystallization, the speed and

degree of which are the lower, the higher the propylene content is [3]. In mixtures based on EPDM, vulcanizing plasticizers are used - low molecular weight polybutadienes with a high content of vinyl compounds and without functional end groups. Based on cold-resistant EPDM and EPDM mixtures, operable in the temperature range from -50 to + 150°C, serial rubbers of the following brands are manufactured: IRP-1375, IRP-1376, IRP-1377, 51-148 [3].

Rubbers based on silicone rubbers have an important advantage - they can be exploited within wide temperature range: from -50 to 250°C (short-term up to 300-330°C), while maintaining resistance to ozone, moisture, UV radiation [3]. The characteristic feature of those rubbers is their increased capability to crystallize with the increase in the density of the spatial network up to a certain limit depending on the type and filler content, and also anti-structuring additive. Rubbers based on SKTE-30 rubber containing ethyl units, as well as SKTFV-2101 and SKFV-2103 containing 8–10% (mole) diphenylsiloxane units are most frost-resistant (they can keep their elasticity at temperatures of -80 ÷ -90°C). Rubber of the following brands is used for production of rubber parts to be operated at temperatures down to -55°C: IRP-1265, IRP-1266, IRP-1267, IRP-1338, IRP-1354, IRP-1401 [3].

Rubbers based on fluorosiloxane rubbers. Rubbers based on SKFT-50 rubber are of particular interest from the standpoint of frost resistance. At a temperature of -90°C, they do not crystallize and do not require the introduction of plasticizers which improve frost resistance, i.e. they do not lose their frost resistance at long-term operation. Less efficient are rubbers made of SKTFT-100 rubber, which work up to -50°C. Coefficient of frost resistance by elastic recovery K_w of rubbers based on rubbers SKFT-50 and SKTFT-100 at -50°C makes 0.6 and 0.2, respectively [3].

In addition to the above mentioned frost-resistant rubbers, there are also a number of rubber compounds. For example, SP-222 or SP-232 based on silicone rubber, capable to stand the temperature range from -100°C to +200°C [4].

Thus, a number of new rubbers capable of operating in a wide temperature range, while retaining their physical and mechanical characteristics, already exist. In the near future, the materials created by the FSUE "VIAM" will be actively introduced into the aviation and rocket fields and industry.

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ADHESIVES USED IN AVIATION WITHIN HIGH-TECH GLUING PROCESSES

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Today, structural and functional adhesives are increasingly used in aircraft products. This is due to the fact that the joints of polymer and metal composite materials, created using high-tech gluing processes, are distinguished by their operational reliability and low weight. Various materials can be glued with adhesives, and these connections will have a long service life.

By fields of application, aviation adhesives can be divided into 2 groups:

- adhesives for structural purposes. These ones include high strength epoxy film adhesives, liquid adhesives and highly elastic phenolic rubber film adhesives.
- functional adhesives. This group includes heat-resistant adhesives and adhesives with special properties.

The article considers aviation adhesives capable of withstanding high temperatures, most of which have been developed by the Federal State Unitary Enterprise "VIAM".

For gluing non-metallic ceramic insulating materials, adhesive VK-78 is used, which is based on silicon nitride and silicon carbide. It works in an oxidizing environment at temperatures of 1400-1600°C for 30 minutes. It is widely used for gluing high-temperature temperature sensors and mounting tooling to the engine surface. Another advantage of this adhesive is that it does not require any special surface preparation for gluing [2].

Adhesives used in high-temperature thermoforming applications are tasked with working over a range of temperatures. VKP-88Ts, a hot-curing adhesive based on a mixture of inorganic compounds, can fulfil this requirement. This adhesive is used for gluing thermocouples of platinum-rhodium-platinum-rhodium (PR) type to the surface of silicon-carbon (SiC) composite samples during bench tests in an oxidising environment and of tungsten-rhenium (TR) type to the surface of SiC system composites during bench tests in vacuum. The adhesives operate successfully in the temperature range 20-1400°C [2].

For bonding steel, titanium alloys, fiberglass, ceramics and heat-shielding materials, K-18 glue is used in disposable products. This glue is capable of performing its functions up to 1000°C [3].

Glue-cement VKP-26Ts is used for fixing wire grating and lead wires of strain gauges on GTE parts during dynamic strain measurements. The glue is created by hot curing on the basis of silicon-organic binder and operates in the temperature range from 20 to 800°C [2].

Adhesive TPK-2 is widely used as a casting material in the manufacture of electric heater connectors as well as for bonding of linings. The glue consists of an aqueous solution of a modified inorganic binder. It withstands temperatures up to 1200 °C [2].

VK-2 is used for bonding metallic and non-metallic materials operating continuously at 400°C and for a short time at 1000°C. This glue is used to repair aircraft engines structure, working rings, guide vanes [2].

Properties of the above adhesives are shown in Table 1.

High-temperature adhesive FTK-VK is used for gluing graphite, carbon - carbon composite materials, refractory metals, providing performance in an oxidizing environment from -50 to +1500°C in a protective atmosphere [1]. The tensile strength is ≥ 10 MPa.

KM-41 mineral adhesive ensures performance of the glued pairs at high temperatures (up to 1200°C long-term) [1]. Adhesive properties are shown in Table 2.

Among the adhesives for structural purposes, the most widely used are high-strength epoxy adhesives, which differ in the range of operating temperatures and are not inferior to the best foreign analogues in their strength and deformation properties. Glue joints based on epoxy adhesives for structural purposes have high long-term strength, vibration resistance, resistance to crack propagation, resistance to climatic factors and aggressive environments, which ensured a long service life and reliability in the operation of glued structures [4].

Table 1- Properties of adhesives

Glue brand	τ_b , MPa		Operating temperature range, °C
	At 20 °C	At increased temperature	
VK-78	12,0	5,0 (400 °C)	1100
VKP-26Ts	Not controlled		20...+800
VKP-88Ts	1,5	—	20...+1600
TPK-2	2,5	2,5 (400 °C)	20...+1000

Table 2 - Properties of KM-41 glue

Shear strength, MPa (steel - steel)	20 °C	2,5-4,0
	300 °C	3,0-5,0
	500 °C	1,4-2,0
	1200 °C	1,0-1,4
Operating temperature		from -60 to -1200°C

In the development of this scientific direction, a high-strength epoxy film adhesive VK-36T for structural purposes has been developed, which, in comparison with the currently most demanded analogue - film epoxy adhesive VK-36, has increased heat resistance - up to 180°C (instead of 160°C - for glue VK-36) [5]. Glue VK-36T provides a high level of strength of adhesive joints in the range of operating temperatures: shear strength at 20°C is 29.5 MPa, at 180°C: 20.0 MPa, and is also efficient for a long time (for 2000 h) at temperature of 180°C and for a short time - at a temperature of 200°C. Table 1 shows properties of adhesive joints made using VK-36T film glue while gluing metallic and non-metallic materials. It can be seen that studies of the strength of adhesive joints after holding in a salt fog chamber for 30 days have shown that the shear strength is 81-86% of the initial one. It has been found that after 90 days of thermal and humidity tests (at a temperature of 60°C, f = 85%), the strength retention was 65-82% of the original, which indicates the moisture resistance of the VK-36T film glue.

Thus, all new adhesives capable of working at high temperatures and in aggressive environments are being actively developed in the Russian Federation.

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УДК 621

POWDER COMPOSITIONS AND COATING PROCESS TECHNOLOGIES BASED ON THEM

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Powder technology currently plays an important role in science and engineering. They form the basis for all kinds of modern technologies: from materials processing, powder metallurgy to additive technology and thermal spraying of protective coatings.

Powder technology is the name given to a number of technological processes carried out in order to produce powders by various methods. In powder technology, the main focus is on particle size and particle shape determination operations, and much attention is paid to the properties of

powders that determine their application area. The regularities of powder production processes are the subject of study in powder technology. This is due to the fact that they determine the physical and mechanical properties of parts made from powders.

Polymer powder compositions (PPC) are finely dispersed materials based on thermoplastic or thermosetting polymers, fillers, hardeners, pigments and other additives. In order to obtain PPC a number of components are mixed in the melt and then the resulting composition is milled to a certain degree of dispersion [5].

Epoxy compositions occupy the leading place among PPCs in terms of production volumes and application, which is due to the availability of raw materials, high technological and operational properties. Coating processes based on them are characterized by high adhesion, mechanical strength and chemical resistance, moisture resistance, resistance to lubricating oils and fuels. Coatings based on them protect products from corrosive influences in various climatic zones. In the presence of UV rays in the atmosphere there is a deterioration of decorative properties (yellowing, loss of gloss, etc.). The temperature range of epoxy coatings is from - 60 to + 150°C, depending on the type of initial binder.

Polyester powder compositions are characterised by high processability and are as good as epoxy compositions. The coatings are characterised by high mechanical properties, light and weather resistance and resistance to UV rays. Chemical resistance of coatings is somewhat lower than that of epoxy coatings. A new class of photochemical curing materials are compositions based on unsaturated polyester binders. The film formation process of such compositions is first heated by IR radiation and the material is fused to form a monolithic coating which is then exposed to UV rays for final curing by a polymerisation process. The curing process is very fast, as it is initiated by radicals which are formed during the decomposition of the photoinitiator contained in the PPC formulation. The technology is preferred for coatings on non-metallic materials (wood, plastics, etc.).

Epoxy-polyester (hybrid) compositions are produced by combining epoxy and polyester binders, which provides coatings with intermediate performance properties. Coatings based on them are close to epoxy coatings in corrosion resistance, but inferior in resistance to various solvents and alkalis. But unlike epoxy coatings, they withstand weathering better and keep their appearance longer in service. Hybrid PPCs are more resistant to overheating than epoxies and do not turn yellow when forming coatings. Coatings based on them are characterized by high quality (surface cleanliness, increased gloss and other properties).

The main advantages of PPCs based on thermoplastic binders are stability of their compositions; fast formation of coatings; availability due to large scale of their production. However, the coatings based on thermoplastic compositions have comparatively low adhesion strength, which can be improved by preliminary surface preparation (shot-blasting or sand-blasting, priming, etc.). In powder technology, polyolefin, polyvinyl butyral, fluoroplastic, polyvinyl chloride and other powder compositions are widely used.

Polyolefin compositions are produced on the basis of low and high pressure polyethylene, polypropylene, copolymers of ethylene with vinyl acetate. Coatings based on them are distinguished by high anticorrosive, physico-chemical and dielectric properties, but low adhesion to various materials, including metals and their alloys.

Polyvinyl butyral coatings are characterised by good adhesion and protective and decorative properties. The main disadvantages of coatings are their low heat resistance and relatively low elasticity. High-dispersed powders with improved adhesion, heat and moisture resistance are used for electrostatic coatings.

Fluoroplastic coatings are characterized by a complex of universal properties: exceptional chemical, heat and frost resistance, good mechanical properties in a wide temperature range, resistance to sudden temperature fluctuations, high antifriction properties, but low adhesive strength. To increase adhesion, a chemical surface pretreatment followed by a primer is carried out.

Polyvinyl chloride coatings (PPC) are distinguished by high chemical resistance to aggressive environments, mechanical strength, good protective, decorative and other properties. Coatings based on plasticized polyvinyl chloride are highly resistant to various detergents and water.

The current methods of applying PPC are as follows: bulk spraying, corona discharge fluidised bed PPC spraying, jet spraying, gas-thermal spraying, electrostatic field spraying, in an ionized fluidized bed, spraying in a cloud of charged powder particles above the fluidized bed, jet spraying in an electrostatic field, triboelectric jet spraying, jet electrophoretic spraying [4].

Due to the fact that in order to form coatings on the surface of the product it is necessary to make the powder composition viscous, i.e. to soften and melt it successively, the thermal effect on the PPC can be done by preheating the coated surface, or subsequent thermal treatment of the product with a layer of PPC in heating furnaces, or its melting using various heating devices.

Among the methods listed above, the most commonly used nowadays are bulk spraying, spraying in a fluidized bed of PPC under the influence of a corona discharge, jet spraying and spraying in an electrostatic field [2]. The mentioned methods of spraying can be considered as combined spraying methods.

Spraying methods are now commonly divided into “hot” and “cold” spraying methods. In “hot” spraying the melting and fusion processes of the PPC particles are heated before they are fed to the spraying gun. The heat source in this case is the flame of the fuel being burned, infra-red radiation from the fuel being burned or plasma in the form of a compressed electric arc [1].

Electrostatic coating methods are the most economical. These methods have a high material utilization factor and allow for coatings on products with complex configurations [5]. To obtain high quality coatings powder particles must be deposited uniformly on the surface.

Electrostatic powder spraying produces an electrostatic streamlining effect, i.e. the ability of charged powder particles to settle on the surface of products not directly exposed to the force field. When charged powder particles fly past the edges of the part, they are subject to aerodynamic and electrostatic forces. In this case, “large” powder particles have a larger surface area and are therefore more susceptible to aerodynamic forces and gravity. If the air velocity near the part is high, these powder particles fly around the edges without settling on the product, while the smaller particles experience a stronger electrostatic attraction to the grounded product. As a result, small powder particles fly out of the air stream and, under the action of electrostatic attraction forces, settle on the opposite side of the product to be coated.

In corona discharge plating, a high voltage is applied to the charging electrodes of the spray gun. This creates an electric field between the surface and the atomiser, the intensity of which is highest at the end of the electrode. This phenomenon results in a corona discharge. Free electrons are formed in the corona area. They attach themselves to air molecules which give rise to negative ions. The high field strength causes the ions to be attached to the PPC particles as they are sputtered. During the spraying process, a cloud of free ions and charged particles of PPC appears between the part and the atomizer. This method of coating is one of the most popular due to the high charging efficiency of most polymer powders. The sensitivity to ambient humidity is quite low [5].

Thus, a variety of coating methods can be used to produce polymer powder coatings. A number of factors have to be taken into consideration when choosing one in order to obtain a powder coating.

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