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National Technical University “Dnipro Polytechnic”
Institute of Economics
Faculty of Management
Department of Foreign Languages
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Virginia International University (USA)
School of Education

WIDENING OUR HORIZONS

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Розширюючи обрії: зб. тез тринадцятого міжнар. форуму студ. і
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Подано матеріали міжнародного форуму студентів і молодих учених, який відбувся 19 –20 квітня 2018 р. в Національному технічному університеті «Дніпровська політехника», м. Дніпро (Україна).
Розглянуто нагальні проблеми економіки, інженерії, а також охорони навколишнього середовища. Особливу увагу приділено сучасному законодавству, спрямованому на вирішення цих проблем. Матеріали згруповано у розділи, що відповідають секціям форуму і відображають сучасні тенденції та інноваційні розробки молодих учених, представників різних країн світу в різних галузях економіки.

Dear Students,

I would like to wish you all the best for your research in your subject field(s). Your detailed studies in your subject(s) will lead to discovering new information and reaching a new understanding.

Importance of research to the university

- Research discovers, elucidates and evaluates new knowledge, ideas, and the technologies essential in driving the future of society and humanity
- Research fosters professional excellence in faculty, important for delivering outstanding student education and training
- When our next generation of practitioners and leaders (students) engage in research, with its deliberate process and requirements for critical thinking skills, they become better students and are best prepared for the challenges and opportunities of the future.
- Research is an opportunity to make a difference and it is open to everyone and thrives on a diversity of approaches and perspectives
- Regionally, nationally and internationally, our research activities and services have critical economic, societal and environmental impacts (CSU,2018)

Research leads to original findings, products, and services. And an important underlying objective of research is the sharing and dissemination of the results of these activities - as during this event.

Good luck!

Ian Firth
[Ian Firth has worked as an EAP lecturer for the University of Ulster, the University of Roehampton, and the University of Leeds (UK)]

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Tetiana Bas
V.V. Protsiv, research supervisor
V.O. Lapina, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Using an Electric Drive with an Energy Recuperation System on Cars

At present, the issue of economical use of fuel resources is becoming more acute. One way to solve this problem is to create hybrid and electric cars. Using an electric drive with an energy recuperation system makes it possible to replenish the energy reserve while the vehicle is moving.

It is known that when the car moves, kinetic energy appears. However, when braking in the traditional form, excess energy is simply lost in the form of heat, the brake pads rub against the brake discs, expending kinetic energy for nothing, heating the friction material and metal, giving out the heat eventually to the surrounding air. This is a very wasteful approach.

The system of recuperative braking does not expend kinetic energy simply on friction in order to brake. Instead, an electric motor that is included in the transmission is used, which starts at braking to function as a generator, converting the torque on the shaft into electricity that charges the battery pack. The braking torque of the rotor, which occurs in the generator mode, just gives the car braking. As such, the energy stored in the battery after a while again serves to drive the car, that is, it is used again.

The use of energy recovery systems has reached the greatest development in the area of urban electric transport and rail transport. However, the main difference of cars from this type of transport is the lack of a contact network, where one could give the energy recuperated during braking. Furthermore, the main problem is the very limited possibility of accumulating recovered energy. This is due to the significant cost of its storage devices and its relatively small number.

It is interesting that modern studies of hybrid cars are mainly related to the simulation of assembly schemes and the determination of traction-velocity properties and energy reserves. Questions of researching brake properties of hybrid vehicles on which the energy recuperation and its accumulation systems are used remain open. Similar works are in the development stage in Ukraine.

In general, there are many unresolved issues related to the process of recuperative braking of vehicles. First, there is no single approach to determining the optimal indicators of regenerative inhibition. Secondly, taking into account modern trends based on an integrated approach to the study of complex vehicle systems and the synergistic effect that appears during the use of the energy recovery system, the task of a comprehensive study of the energy recovery system and its properties arises. Thus, the study of energy recovery systems on vehicles remains relevant.

Konstantin Bondarenko
V.O. Sviatoshenko, research supervisor
V.V. Hubkina, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

The Transmission of Data by Using Optical Fiber

The number of Internet users is growing every day. At the same time, there are growing demands for companies providing access to the World Wide Web. As most users want to watch video online without delays and have the ability to download files without wasting a lot of time increasing data transfer speed as well as reducing the amount of interference that also affect the quality of the Internet are especially important criteria. Nowadays, there are many ways to get access to the Internet. The main ones are data transfer in a solid medium (cable connection) and a wireless communication (Wi-Fi, mobile broadband and satellite connection). At the moment, the most advanced technology for data transmission in a solid medium is optical technologies. These technologies are implemented by applying an optical fiber. The optical fiber is one of the most advanced methods to transfer data by converting the necessary information into light pulses, which move along a glass or plastic strand (fiber). Such a cable can consist of a different number of these fibers (the total number of them varies from 8 - 144 in one plastic tube).

So let's deal with its design. The optical fiber cable consists of several layers:
1) Double-layered glass or plastic fibers wound on the supporting cable providing rigidity to the whole structure; 2) Plastic tubes comprising fibers–light guides and filled with hydrophobic gel; 3) Fiber-wrapping membrane designed for reducing friction inside the cable and complementary protection against moisture; 4) A few more layers intended to enhance the protection both against signal interference and mechanical influences, which can damage the design.

This technology of data transfer has many advantages. One of the most significant is the speed. Depending on the length of the fiber the data transfer speed reaches from several hundred Mbit/s and up to about 10 Gbit/s. Such a speed is available because the information is transmitted by the light pulses, and the speed of light is really high value. Besides, a significant advantage of this technology is its protection as its design has several layers of protection. Furthermore, optical fibers have a high throughput and broadband.

But despite this, there are some disadvantages either. The most serious drawback of this technology is the cost of posting. Yes, for a large company, perhaps such a price will not be significant, but for a common user, it can be quite high. Therefore, data transmission technologies can be often combined (for example, the optical fiber can be combined with a twisted pair).

The optical fiber is the basis of the ultra high-speed network, which allows providing TV, phone, video conferencing, IT data transmission, ultrafast Internet access and many other services.

Tatyana Chernyak
A.A. Martinenko, research supervisor
V.V. Zabolotnikova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Fitness trackers

Fitness trackers can be safely attributed to technical innovations.

There are some basic characteristics typical for all devices, regardless of price and brand.

The option of counting the steps, the calories burned and the possibility of installing an individual program will help to carry out the most productive workouts.

The pulse measurement option is very important for training because if the threshold is exceeded, the tracker will notify you about this by sound or vibration signal. Thus, excessive loads can be avoided.

Function of measuring pressure: these trackers will perfectly suit as clever assistants to the elderly.

Notifications from social networks, SMS messages and calls with the option of resetting an incoming call come on fitness trackers in the form of vibration. This function is also indispensable for people who due to age or illness have hearing problems or simply in noisy places.

Track the sleep phase thanks to the smart alarm function. The peculiarity of this function is that an intelligent bracelet wakes you up at a time when it's easier for you to wake up. Naturally, you can set an approximate framework to wake up at the right time for you. In the morning you can see detailed statistics, for example, periods of deep and fast sleep.

Still in all fitness trackers there is an option “do not sit back” which at some long inactivity reminds by an audible or vibro signal that it is time to be warmed up.

In newer and more expensive models there are a number of additional functions.

For example, some sports bracelets can work in water. A fitness tracker will count the distance that you sailed, and can also show even the total number of strokes that you have made.

Fitness tracker will allow you to monitor your food in detail.

There are also such fitness trackers that scan products online. This is done by barcode.

This is only a small part of fitness tracker functions and area of its use which obviously proves the device viability and marketing potential.

Oleksandr Demidov
I.G. Hulina, research supervisor
V. V. Hubkina, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Healthcare Improvement Empowered by the RFID Technology

Nowadays, healthcare processes are rapidly changing. Every second plenty of companies try to ruin old biases and set up the new point of view. That is why the problems with resolving and identifying data as well as tracking information are tremendously vital. As a result, we need fast, powerful and simultaneously cheap solution to tackle with this challenge.

According to the huge amount of observations, the RFID (Radio Frequency Identification) technology is one of the most appropriate tools to be used. The reason for this is a well-balanced combination of the quite low price and the high efficiency of data processing. In addition, RFID technology has already proved its convenience in such various areas as security, library funds and service industries. Thus, we can surely claim about its integration into the healthcare system.

Let us move on to the RFID mechanism and its construction. In general, RFID has been developed for unique identification of items (objects) and contains several components, which interact with each other. It should be noted that RFID uses software and hardware parts. More details will be given afterwards.

It is known that RFID system consists of tags that have unique ID for identification. Another component is RF antennas used for reading tags and having their own magnetic field. RFID reader is another one to handle antenna signals and manipulate with tag information. Also, communication infrastructure takes place and works as a middle layer between application software and reader. And finally, it is the application software that enables users to look through RFID information.

RFID tags can be grouped into three categories based on frequency range used to communicate data. They can be listed as following: low frequency (LF), high frequency (HF) and ultra-high frequency (UHF). Generally speaking, the lower is frequency, the shorter is reading range and slower the data reading rate. Therefore, **Low Frequency (LF) RFID** operates within the range of 30 KHz to 300 KHz, and has the reading range up to 10 cm. **High Frequency (HF) RFID** operates within the range 3 MHz to 30 MHz and provides reading distances of 10 cm to 1 m. Having a frequency range between 300 MHz and 3 GHz, **Ultra-High Frequency (UHF) RFID** offers and provides faster data transfer rate and reading ranges up to 12 m.

In spite of convenient way of use, RFID solutions are able to possess inappropriate combination and selection of components, which may contain some errors and mistakes. In addition, the wrong software configuration can cause some threads and vulnerabilities. The list of advantages and disadvantages can be seen in Table 1.

Table 1 Advantages and disadvantages of RFID system

Advantage	**Disadvantage**
High speed	Interference
Multipurpose and a great number of formats	High cost
Man-power reduce	Some material may create signal problem
High accuracy	Overloaded reading (fail to read)
Complex duplication	
Multiple reading (tags)	

It should be concluded that due to huge changes related to the healthcare system of Ukraine, we have to empower healthcare processes with new technological solutions. Unfortunately, all improvements are quite expensive and will not be carried out without foundation. But some of them are really useful and deserves our attention, namely, RFID. It gives a great possibility in such various ways as equipment handling, drugs transportation, blood sample administration, patients' notes management and others. So, one small step for a medicine is followed by one giant leap for mankind.

Mykhailo Derkach
A. A. Kolb, research supervisor
N.M. Nechai, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Bladeless wind generator

The world needs cheap and environmentally friendly electricity because hydrocarbons will end sooner or later, and they cause damage to the environment. In this light, wind power looks perspective as it is inexhaustible and environmentally friendly. But wind power stations of traditional design cannot satisfy the need in electric energy, so there is a need to search for new design solutions of more efficient use of wind energy. One of the perspective solutions is a bladeless wind generator from the Spanish company Vortex Bladeless.

This vertical bladeless wind turbine looks like a huge baseball bat fixed on a handle and swaying in the wind. The principle because of which it sways is an oscillating flow that takes place when a fluid such as air or water flows past a cylindrical body. In this flow, vortices are created at the back of the body and detach periodically from either side of the body. This effect is called *Von Kármán vortex street.* It is destructive for building structures, that is why construction engineers prevent the possibility of the structure to enter resonance.

Vortex Bladeless engineers decided to make use of this destructive effect. They specifically carried out research in the wind tunnel to find the shape of a generator that would be more responsive to resonance. Vortex's innovation comes from its unusual shape, where a fiberglass and carbon fiber mast oscillates in the wind taking advantage of the *vortex shedding effect*. At the bottom of the mast a carbon fiber rod moves inside a *linear alternator* that generates the electricity, with no moving parts in contact. Vortex has a small carbon footprint, is noiseless, has low center of gravity and allows for small foundation dimensions, so more generators can be placed in an area, at twice the density of traditional turbines.

As Vortex Bladeless say, comparing with a traditional wind power turbine of the same power, their bladeless generator will be:

- 53% off in manufacturing cost – because it requires less materials;
- 51% off in operating costs – because of absence of moving parts in contact;
- 80% off in maintenance costs – because it has simpler construction;
- 40% global power generation costs reduction – because of advantages above;
- 40% carbon foot print reduction – because it’s easier in manufacturing, transportation and maintenance.

This innovative concept has other advantages. It starts to oscillate by the lower speed of the wind. It is possible to locate stations much closer to each other. Wind

turbines of the classical design with a dense arrangement do not receive enough wind flow, but this bladeless generator only benefits from dense placement as its oscillatory effect is amplified by the vortices from the generator ahead. Also, it produces almost no harmful noise, it is safe for birds and doesn't clutter the horizon.

Vortex Bladeless is currently developing three different products. The main characteristics of the three products are:

- Vortex Atlantis: 3 meters height and 100W generation capacity, working along with solar panels, mainly to bring energy to off grid locations.
- Vortex Mini: 13 meters height and 4 kW generation capacity, mainly for small-scale/residential wind.
- Vortex Grand: 150 meters height and 1MW generation capacity, capable of generating electricity for 400 houses.

Atlantis and Mini models are planned to be introduced for private homes in developing countries, or small constructions like radio antennas with their first field tests in Avila, Spain. And by 2018, with help of crowd funding the deployment of the Vortex Grand is planned.

Until there is no final product it's hard to forecast which problems can occur, but as I think that possible problems will be: vulnerability to storm winds, and vulnerability to icing at sub-zero temperatures, what will disrupt the aerodynamic properties of the generator.

In summary, we can conclude that bladeless generators can be one of those non-standard, forward-looking solutions in clean energy. Because the era of hydrocarbons is coming to an end, nuclear power is potentially very dangerous, but people still strongly need a reliable source of clean energy.

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Natalia Dreshpak
G. G. Pivnyak, research supervisor
S. I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Methodology for determining heating mode parameters in electrotechnology of machine parts dismantling

Cylindrical steel connections of machine parts (bushings to a shaft) made with an interference fit are widely used in machine-building and mining. While repairing and testing machines it is necessary to perform dismantling. Connections dismantling realized by means of the axial loads using removers accompanied with damage surfaces as emerging surface scratches. Heating details connections permit avoiding undesirable consequences. At the same time connections heating modes that lead to interference liquidation and conditions necessary to dismantle the site are not studied enough. Lack of theoretically substantiated mode parameters results in practical use of induction heating systems with unsuccessful constructive decisions and relatively low technical and economic factors.

The choice of P_0 level significantly influences the thermal process character [1]. It is proposed to set the value of P_0 to provide the required level of ΔT_T in transient heating mode [2]. The value of P_0 is received from the formula

$$P_0 = \alpha_в \cdot \Delta T_T \cdot \frac{R_2}{R_1}, \quad (1)$$

where R_1 and R_2 are external and internal bushing radii.

Contact thermal conductivity between the bushing and shaft $\alpha_в$ is defined experimentally identifying its value directly on the object to be dismantled. During low-temperature stationary heating measurements are made on the lateral surface of internal $T_н$ and external $T_в$ temperatures of its surfaces (Figure 1).

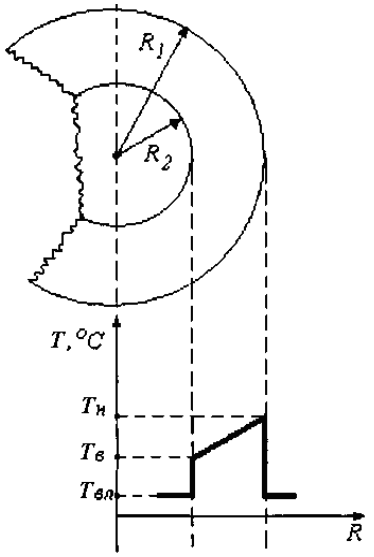

Figure 1. The Characteristic of Temperature in a Stationary Connection Heating Mode

The value of $\alpha_в$ is received from the formula

$$\alpha_в = \frac{(T_н - T_в)\lambda_{ст}}{(T_в - T_{вл})(R_1 - R_2)}, \quad (2)$$

where $\lambda_{ст}$ is the factor of thermal conductivity of steel.

When choosing the current frequency of induction installation it is offered to use inequalities

$$X_n \le \Delta_в;\ \Delta_е \le \Delta_в / 1.68, \quad (3)$$

where $\Delta_в$ is bushing thickness; $\Delta_е$ is the depth of penetration of electromagnetic waves, calculated on the basis of the value of μ on the bushing surface ($\mu_е$).To limit mode $\Delta_е = \Delta_в / 1.68$ "deep" bushing heating is typical. This mode corresponds to the lower recommended value of inductor current frequency $f_н$. Figure 2 shows the dependence $f_н(P_0)$.

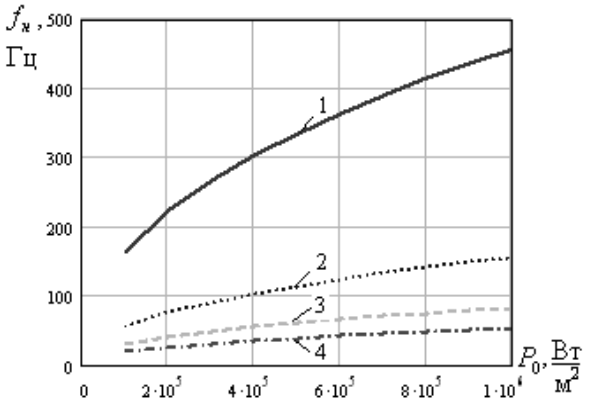

Figure 2. $f_н(P_0)$ Dependencies: 1 – $\Delta_в$ = 0,005 m; 2 – $\Delta_в$ = 0,01 m; 3 – $\Delta_в$ = 0,015 m; 4 – $\Delta_в$ = 0,02 m.

Figure 2 shows that at the bushing thickness being less than 2 cm it is possible to carry out heating with the industrial current frequency of 50 Hz. Under lower thickness values and also under size restrictions in design it is reasonable to use high frequencies (kHz).

The developed mathematical model focuses on determining the mode parameters that guarantee temperature conditions for connection dismantling and improve technical and economic factors of induction installations (reducing mass, size, and cost). If the method is available the savings for one installation purchasing is several thousand dollars.

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Oleksandr Dreshpak
P. I. Pilov, research supervisor
S. I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Mathematical model for calculating enrichment efficiency

Mathematical models for the enrichment efficiency indicators calculating are well known. These models are based on probability theory and mathematical statistics methods [1]. The basis of such modeling is random values functions determination defining the raw materials parameters as well as the separation characteristics used for the equipment classification. For raw material of heterogeneous carbonate deposits such models were not created.

The identification of regularity of stochastic bounds of limestone mass fraction in the mineral with the particles size mentioned in research paper [2], allows us to apply a new method in order to create a new model which takes into account the results of granulometric (raw materials separation into size classes) and chemical (limestone percentage determination in each size class) compositions of raw material. The use of regression analysis for raw material experimental data processing, provided as discrete parameter values, allows us to obtain regression equations defining the stochastic bounds between the quality of the oversized product of the classification device (screener) and the size of d particles separation.

The process of the raw material enrichment with classification devices usage must be accompanied by the oversized product quality improvement and the target component (limestone) content decrease in the undersized product. Moreover, the weight indicators are important for the effectiveness evaluating. These components show us the enrichment efficiency parameters E

$$E = \frac{\varepsilon_1 - \gamma_1}{1 - \alpha}, \quad (1)$$

in this formula ε_1 – limestone extraction into the oversized product; γ_1 – oversized product output; α – limestone content in the source material.

The parameters of formula (1) are measured in unit fractions.

The value of the oversize product (concentrate) output is obtained from formula

$$\varepsilon_1 = \frac{\gamma_1 \beta_1}{\alpha}, \quad (2)$$

in this formula β_1 – the content of limestone in the oversized product (concentrate).

An important parameter of material device effectiveness classification is an indicator of classification process effectiveness. Using screener as a classification device a material screening effectiveness is to be considered E_{screen}

$$E_{\text{screen}} = \frac{m_2}{m_{2d}}, \quad (3)$$

in this formula m_2 – undersized product mass; m_{2d} – the mass of lower size class particles in the initial product;

E depends on the separation size d of the raw material by the screener. The higher the level of d separation the more material will be in the undersized product which leads to the *E* value change because different size classes have different limestone concentration [2]. The *E* dependence (d) can be obtained by means of regression equations using which connect material mass $m_{2d}(d)$ and limestone mass $m_{u2d}(d)$ with d parameter value in the lower size classes of the raw material. In relative units such dependences have the following form $m_{2d}/m(d)$ and $m_{u2d}/m(d)$, in these formulas m – the mass of source material. Such regression equations obtaining is possible by experimental raw material data analyzing represented in [2]. The function *pwzfit* of MathCAD system allowed us to obtain the following regression dependencies.

$$m_{2d}/m = 22.2d^{0.347}, \quad (4)$$

$$m_{u2d}/m = 7.88d^{0.449}. \quad (5)$$

The calculated values of the correlation ratios r for the nonlinear models are the following: - for the curve (4) – r = 0.989; - for the curve (5) – r = 0.992.

Figure 1 illustrates the obtained dependencies in the following graphic:

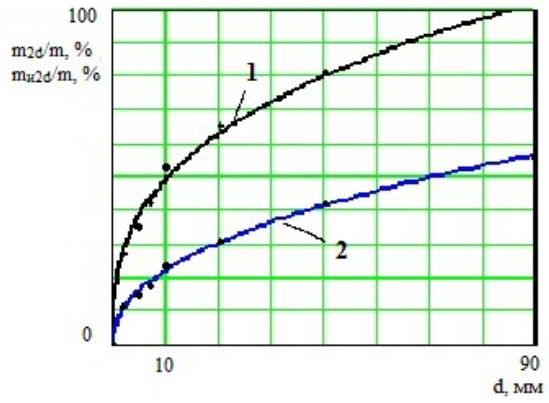

Figure 1. The dependences $m_{2d}/m(d)$ – curve 1 and $m_{u2d}/m(d)$ – curve 2.

Such high levels of correlation ratios allow us to consider the dependences (4) and (5) as functional links between parameters and to use them to calculate enrichment efficiency indicators. Such significant r values allow us to suppose the existence of strong links between the parameters due to the geological conditions of minerals formation and to confirm the acceptability of power functions in regression dependences.

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Vladyslav Dykyi
S. I. Fedorov, research supervisor
L.A. Zaika, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Organization of Invariant Amplification-Conversion Systems

The current level of development of radio engineering systems is directly related to the problem of creating functionally and energetically efficient electronic equipment. This problem is especially important in recent years in connection with the development of microelectronics and semiconductor technology. This fully applies to the amplification and conversion systems (ACSs), which are part of a variety of info-communication equipment (ICE). The current level of the development of the hardware of the IKO, the constantly increasing requirements imposed on them, require the development of the ACS, which would combine the functions of forming a high-quality output signal and wide-range regulation (stabilization) of its parameters, thereby ensuring high energy and dynamic indicators. Necessity in such UTS is felt in the development and creation of various systems for the reproduction and strengthening of information of remote-controlled autonomous aerospace and deep-sea complexes, in particular, unmanned and spacecraft, automatic probes, robotic complexes, automated telecommunication systems, radio navigation and hydro acoustics used in the equipment of autonomous objects (AO). The work on creation of autonomous underwater vehicle is conducted at the Department Renewable Energy Sources, under the control of the c.t.s. Kirilova I. A.

The discrepancy that is regularly detected between the characteristics of the ACS and the continuously growing demands placed on them is a powerful and constantly acting stimulator for improving the UPS. At the same time, the growth of information throughput is accompanied, both by the expansion of the functionality of the ACS, and by the increase in energy costs. In addition, modern ACS works normally as part of complexes and, therefore, must satisfy the conditions imposed on the complex, for example, the condition of electromagnetic compatibility. Such ACS can have a large number of consumers, therefore the need for the ACS to work on a given schedule, the ability to rebuild the structure of the ACS, synchronize its operation significantly distinguish the ACS from known systems for which the sequence of change of operating modes and special requirements for characteristics is usually not regulated. Consequently, we are talking about self-adjusting multi-mode ACS.

An effective means of ensuring the specified characteristics of the ACS is to use the provisions of the theory of invariance, which is complicated by the nonlinearity of discrete automatic control systems in the construction of a modulation-type ACS, such as modern control systems. At the moment, many theoretical and practical issues related to the creation of structurally invariant ACS have not been solved. In

addition, the actual problem is the provision of specified characteristics with appriorial incompleteness or lack of information on the coordination-parametric effects on the system, which leads to the need for an adaptive approach.

The widespread use of robotic systems has created the problem of increasing the flexibility of the ACS and the reliability (fault tolerance and survivability) of this type of computer. As a result of the increase in these indicators and the quality of the decisions made, by improving only the hardware of the ACS structures, at a certain stage the level of automation of various kinds of technological parameters has significantly increased. Analysis of the results of the use of such complexes in systems with an increased degree of responsibility indicated the existence of limits of possible levels of attainability of these indicators for circuit implementation, for example, increasing the functionality of the ACS by increasing the complexity of hardware implementation leads to a decrease in fault tolerance and survivability of the system as a whole. Therefore, one of the possible ways to solve this problem is to reduce the level of complexity of the implementation of software and hardware used by the ACS by increasing their "intelligence".

At the same time, the requirements for the implementation of specified performance characteristics are presented to the ACS provided that the system's output coordinates are fully invariant to processes in the primary energy sources. The implementation of the specified performance characteristics provides for the invariance of the output coordinates of the ACS, not only to the disturbing effects, but also to the form of the converted electric power. This necessitates the expansion of the functional and dynamic capabilities of the systems.

The absence of a single methodological approach to the construction and analysis of invariant ACS with given characteristics of functioning significantly complicates the task of creating them and does not allow ensuring the implementation of the requirements that are imposed on such systems.

The main problem of the theory of invariance is the search for such conditions for the structural construction of an ACS, in which the motion of one or several coordinates of the system does not depend on one or more input influences applied to the system. Two cases are the most interesting.

Output effects are amenable to immediate measurement, but the laws of their change over time are unknown beforehand. In this case, the structure of the system must ensure the independence of the coordinate motion for any admissible change in the input influences.

Input effects cannot be directly measured. In this case, the structure of the system must ensure the independence of the coordinate motion for any admissible input action. At least, this independence must be fulfilled with a certain degree of accuracy.

Anastasiya Glynska
V.I Korsun, research supervisor
V.O. Lapina, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Crystal Identification in Positron Emission Tomography

Positron emission tomography is a radionuclide tomographic method of examining the internal organs of a person or an animal. It is an actively developing diagnostic and research method of nuclear medicine. This method is based on the possibility, with the help of special detection equipment (PET scanner), to track the distribution of biologically active compounds labeled with positron-emitting radioisotopes in the body. Modern Positron Emission Tomography (PET) detectors typically are made from 2D modular arrays of scintillation crystals. Their characteristic flood field response (or flood histogram) must be segmented in order to correctly determine the crystal of annihilation photon interaction in the system. Crystal identification information thus generated is also needed for accurate system modeling as well as for detailed detector characterization and performance studies.

The semi-automatic general-purpose template-guided scheme for segmentation of flood histograms was presented. It generates a template image that exploits the spatial frequency information in the given flood histogram using Fourier-space analysis. This template image is a lower order approximation of the flood histogram, and can be segmented with horizontal and vertical lines drawn midway between adjacent peaks in the histogram. The template is then registered to the given flood histogram by a diffeomorphic polynomial-based warping scheme that is capable of iteratively minimizing intensity differences. The displacement field thus calculated is applied to the segmentation of the template resulting in a segmentation of the given flood histogram. Then the scheme is evaluated segmentation scheme for a photomultiplier tube-based PET detector, a detector with readout by a position-sensitive avalanche photodiode (PSAPD) and a detector consisting of a stack of photomultiplier tubes and scintillator arrays. Further, the performance of the proposed method is quantitatively compared to that of a manual segmentation scheme using reconstructed images of a line source phantom.

For detailed characterization of PET detectors in a scanner and consequently, for accurate system modeling and image reconstruction, parameters like energy resolution, timing resolution and light collection need to be measured for each crystal in the system. This is because individual crystals even in the same detector array can have different detection efficiencies, varying energy deposition characteristics, and diverse optical photon collection properties.

Modern PET scanners typically have thousands of crystals. The most time consuming method for segmentation of flood histograms is to manually select the peaks by clicking at appropriate points on the computer screen and then use the binary file thus created (1 corresponding to pixels clicked and 0 otherwise) as an input to a standard segmentation method, e.g. the watershed method. A semi-

automatic method where the manual process was replaced by background subtraction of the flood histogram followed by spatial filtering for noise removal and peak identification by intensity-based thresholding was developed by Mao. This method, however, was not robust for identification of edge crystals due to the hard thresholding condition and hence, considerable time was needed for manually correcting the segmentation. An approach using Gaussian mixture models (GMM) for segmenting flood histograms from multilayer GSO-based depth-of-interaction (DOI) capable detectors was proposed by Yoshida. Their approach performed well for complex flood histograms of individual blocks, but was impractical for the flood histogram of the whole detector because a large number of parameters for the GMM must be estimated.

The measured flood histogram was used to obtain the template then was registered to the target using fifth-order polynomial warping. Outcomes of the warping process are shown in Figure 1. The estimated transform was used to generate the modified target shown in Figure 1(a). Figure 1(b) shows the overlay of the estimated segmentation boundaries on flood histogram under consideration. After the segmentation process was repeated for another flood histogram obtained when the source was collimated at a depth of 18 mm from the PSPMT. The results in this case are shown in Figure 1(c). The flood histogram obtained from a singles mode measurement was also segmented and the results are shown in Figure 1(d). The procedure for segmentation for Figures 1(c) and (d) was the same as that for Figure 1(b), and hence, intermediate results are not shown. The computation time for obtaining the final segmentation in each case was around 47 sec for the (256 × 256) images. The proposed method indeed was able to segment all 196 crystals with reasonable accuracy in each of the three cases.

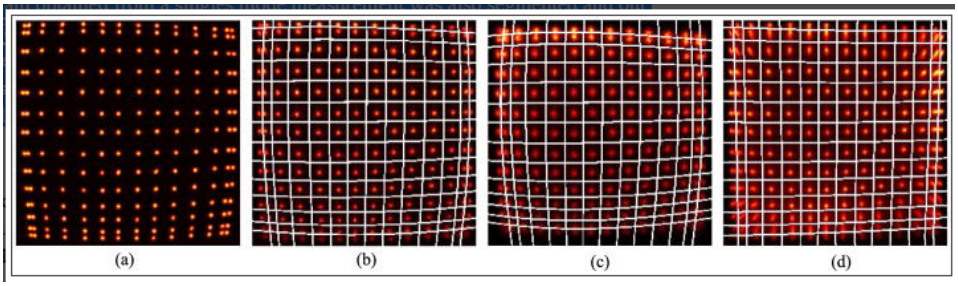


Figure 1- Segmentation of the PSPMT (multi-channel position sensitive with multiplexed readout, the X and Y positions)-based detector

The semi-automatic segmentation scheme presented here produced accurate delineation of crystals from flood histograms obtained from PMT-based and PSAPD-based PET detectors, including those with stacked detector geometries. While providing manual control necessary for exceptional cases, the scheme attempted to keep human involvement to the bare minimum. The adaptive method proposed for the generation of PSAPD flood histograms resulted in reduced spatial distortions and was found to be beneficial for crystal identification. The proposed segmentation method can easily be applied to a wide variety of PET cameras designs and potentially should facilitate accurate and accelerated system characterization.

Oksana Holub
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

What is the future of electric cars?

The future is electric. All over the world electric cars are likely to take at least half of all new car sales by 2040, because in the US in 2016, sales grew by 37 percent, as analysts say. The largest automakers in the US and abroad are struggling to keep pace with the times and announce their plans for electrification. BMW, Audi, Volkswagen and Volvo, are developing new technologies for electric vehicles and increasing their offers for electric vehicles.

Soon, electric cars will cost about the same as conventional cars with a gas engine, because the prices of the battery continue to fall, and the technology is fine-tuned, according to Simon Mui, director of energy for non-profit national resource protection.

Tesla unlike any other company has done a lot for the market of electric vehicles, promoting science and economics to unknown territory. Musk's dedication to doing this has forced the big automakers to follow suit.

Tesla's valuation of more than $ 50 billion and the success of the S and X models on the market prove that the market for electric vehicles is being sold. Musk also showed that a start-up that wants to think about large boundaries can force the world's largest car manufacturers to rethink their own strategies and change direction.

As the world’s automakers place larger bets on electric vehicle technology, many industry analysts are debating a key question: How quickly can plug-in cars become mainstream?

Many people and experts believe that electric cars will remain a niche product for many years, suffering from high prices for stickers and heavily dependent on government subsidies.

Bloomberg predicts, hybrid and fully electric cars will account for 54% of new passenger sales worldwide for the year 2040. There is a simple explanation for this: batteries. Since 2010, the average cost of lithium-ion batteries was about $ 300 per kilowatt-hour. Bloomberg says that by 2030 it will fall to $ 73, without any significant technological breakthroughs, as companies such as Tesla, increasing the production of batteries in mass plants, optimizing the design of batteries and improved chemicals.

So we can say that the future is for electric cars, the demand for these cars is growing, and the price will decrease with time and who knows, maybe in 20-30 years we will not see cars with an internal combustion engine on the roads.

Yaroslav Hovorukha
V.I.Shevchenko, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Current State and Perspectives of 3D Printing

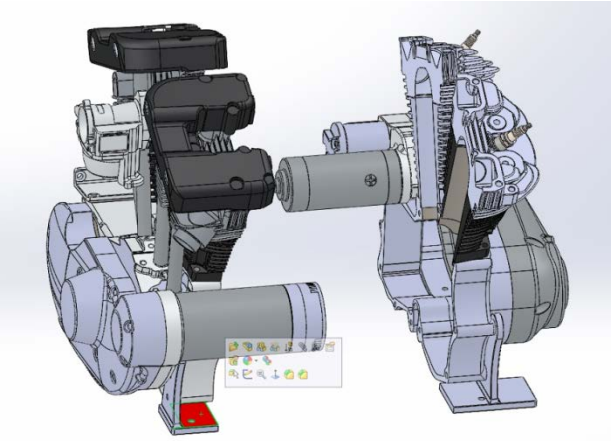
Imagine the situation when you urgently need to buy a chair or table for the kitchen. Now you, most likely, would go to a regular store for this purchase. At best, you would look for the goods on the Internet. But it's not long before you can get a unique chair or table not only without leaving home, but even without any mediation on the part of the sellers or the delivery service of the store. The main thing is that you have a 3D printer at home.

All this may seem fantastic, however all this is already functioning. This is a reality, which is still used to solve a narrow range of problems. But the mass introduction of technology into everyday life is not far off.

3D graphics is a section of computer graphics that is designed to provide the space-time continuity of the images obtained.

A three-dimensional image differs from a flat one by constructing a geometric projection of a three-dimensional model of a scene on a computer screen using specialized programs.

To obtain a three-dimensional image, the following steps are required: modeling and rendering. Modeling is the creation of a mathematical model of the scene and objects in it. Rendering is construction of the projection in accordance with the chosen physical model.



Modeling

Until recently, 3D-printers were considered to be science fiction, able to reproduce the details of their own design, that is, to reproduce themselves. Now the development of such a machine is being carried out by the RepRap project , at the moment the printer already produces more than half of its own parts. The project is a

development with publicly available developments and all information about the design is distributed under the terms of the GNU General License Public License.

The project is the first in the history of inexpensive self-reproducing (that is, capable of recreating at least a part of itself) of a three-dimensional printer - RepRap is being actively implemented in our days by the English designers of the University of Bath. "The most important feature ofRepRap is that from the very beginning it was conceived as a replicating system: a printer that prints itself" (Adrian Bower , one of the RepRap project staff). With a 3D-printer, you can use it to print another 3D-printer.

3D-printing technologies already allow you to "overtake" the digital form, say, "Mercedes", and then, having thrown off its digital model to the other end of the world via the network, so that it can be unsealed there in some quiet Moroccan courtyard of an inconspicuous private house. News headlines such as "the *latest model of" Mercedes "again trickled into torrents* " in the future can become commonplace.

In advanced *robotics*, the dominance of 3D printing is also noticeable, for example the already famous robot AlphaDog is almost one-third assembled from parts printed on such a printer.

3D-factory in New York called *Shapeways*, at the moment is the largest factory of 3D-printing in the world, which is able to produce in less than a day almost any mechanical device (rocket engines, described earlier, are done there). It is the world's largest manufacturer of products "to order".

What will happen to the world further, when the former economy becomes impossible when it becomes possible to freely exchange digital models of things and their exact prototypes, and then to embody them in metal with a single click of a button? Most likely, in some countries this will be prohibited. Hundreds of thousands of people will become independent private producers, while simultaneously becoming autonomous digital consumers.

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Dmytro Kavun
O.S. Kuchin, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Modern program of surveying works automation

In modern conditions of science development, mining industry is closely connected with automation of informational provision of mine workings at all stages of extracting mineral resources. Active use of computer technologies in mine surveyor's workings started in 90-es. However it often boiled down to using imported programs. Experience of work with these programs shows that they are too expensive, not translated, too difficult, do not consider particularities of domestic equipment and require high level of workers qualification.

Starting from 1996, "Laboratory of Complex Technologies" (Pavlograd, Ukraine) have developed new technology of automation of mine surveyor's department. And now, after large amount of hard and strained work, there is coming new modern technology – SAMARA (System of Automation Mine Surveyor Workings). This technology allows building and using three-dimensional models for solving different problems. The model contains graphical files and external database that has additional information about geometry of mine workings, mineral deposit and etc.

SAMARA is based on AutoCad, that's why SAMARA is easy to use and understand. The main task of this technology is building three-dimentional models of definite square in different scales.

The most convenient method of point measuring for building our model is laser scanning and tacheometry. As a result of laser scanning we get a lot of points that cover an object. However small and medium enterprises cannot afford using this equipment.

In SAMARA program, volume of mineral resources is measured by method of three-dimensional figures. The main idea of this method is that on the surface of spoil bank, definite measured area is multiplied by average height of this area. First of all, we have to find appropriate distance between the points. If the distance is too small the program will fail because of a lot of information, and will not save any results. If the distance is too big we'll get a great error in measuring of volume of mineral recourses. After all these processes in SAMARA we may build our model. So, in conclusion, SAMARA program has the following advantages: it is unique and easy-to-use, has intuitive interface and high accuracy of measurement.

Stanislav Kobylianskyi
A.V. Rukhlov, scientific supervisor
N.M. Nechai, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

The problem of uneven schedule of the electricity consumption of Ukrainian electricity grid

The total estimated capacity of Ukrainian power plants at the end of 2015 amounted to 55.1 GW, of which thermal power plants (TPP, CHP plants, block stations) account for 62.2%, nuclear power plants (NPP) represented 25.1%, hydroelectric power plants (HPP) and pumped storage plants (PSP) – 10.6%, power stations, powered by alternative energy sources (WEEE, SES, biomass energy) had a share of 2.1%.

According to the "Energy Strategy of Ukraine for the period up to 2030" (version 2015) and "The Plan for the Development of the United Energy System of Ukraine for the next ten years" (version 2015), by the end of 2014, most of the generating assets of bulk and interstate power networks had been worn out and ineffective. 83% of the power units of the TPP and CHP have worked more than 200 thousand hours (marginal resource), are physically depreciated and obsolete, and need to be modernized or replaced. Deprecation of equipment leads to over-consumption of fuel, reduction of working capacity and deterioration of environmental indicators. NPPs are approaching the end of the project lifetime: more than 70% of nuclear power units will need to extend their service life in the next 10 years. The balance of power of the United Energy System (UES) of Ukraine is characterized by a shortage of manoeuvring and regulating capacities; The share of HPPs and PSPs, which provide the main volume of motor power, in the overall balance is about 10%. As a result, the units of the TPP and CHP, designed for operation in the basic mode, are used to support the variable section of the load schedule. Over 90% of 220 kV overhead power lines and 55% of main substation equipment have already used the estimated technical resource (25 years); 56% of transmission lines (LP) and 17% of substations (PS) have been in operation for more than 40 years.

The analysis of electric load schedules (ELS) of Ukraine's power grid for different seasons shows that the lion's share of a manoeuvrable part, which varies from 4-5 GW (in summer) to 6-8 GW (in winter), is covered by solid fuel power units of the TPPs, designed to operate in the base part of the ELS. Therefore, the structure of the generating capacities of the UES of Ukraine is unfavourable provided that the load schedule is adjusted and does not correspond to the ratios of the base and peak capacities necessary to ensure the regulation of daily consumption in the grid:

- the NPP share (basic mode) ranges from 55 to 40% in the coverage of the winter minimum and the maximum loads;
- the range of CHP regulation determined by the heat supply regime is not more than 20%;

- Production plants operate on a schedule, and as well as TPPs, do not have economic incentives to participate in regulation.

Under these conditions, the main burden of adjusting the load schedule falls on coal units of 150-200-300 MW. The low quality of coal and technical constraints (primarily due to technical wear and tear), result in the actual regulatory range of coal blocks of 20-25% instead of the designed range of 30-40%. Due to the unfavourable power structure (low percentage of manoeuvrable power, limiting the regulatory range of TPPs), the power system practices daily stopping of 7-10 blocks for the off-peak night periods with their subsequent launches to morning / evening maximum load. Such practice results in depreciation of equipment, increased accident rate and fuel overrun.

The dynamics of using the capacities of Ukrainian thermal power plants testifies to their physical and moral deterioration. Thus, in 1990, the index of utilization of estimated capacity of TPPs amounted to 68.4%, in subsequent years gradually decreased and in 2005 it was 27.6%. At the same time, the specific costs of indicative fuel at Ukrainian TPPs increased for the same years from 346.1 to 373.4 g/kWh. In recent years, this indicator has approached 400 g/kWh.

The most effective state approach, which can solve the problem of covering the unevenness of the electric load schedules should include:

- the creation of the optimal structure of power generating capacity of the power system;

- using overflows with adjacent energy systems;

- introducing administrative (limiting) and economic (incentive) measures to stimulate consumers balance the load schedule of the power system. For this purpose, it is reasonable to use consumer regulators (CRs) that can limit or transfer a part of their power load from one hour to another (daily regulation) or from working days to days-off (weekly regulation) [1]

Unlike other stations, PSPs, including TPPs and HPPs, have a double regulatory effect. So, the same estimated capacity (in generating mode and in pumping mode) can be used both to lift the night dip of the daily load schedule (when working in the mode of charging the station), and to cover the peak loads (in discharging mode).

The resources of power generation of the Ukrainian power grid are on the brink of exhausting physical capabilities to ensure daily regulation of the load and rational modes of operation of the power plants. Therefore, in the near future, it is necessary to carry out their reconstruction, along with the introduction of new highly manoeuvrable capacities.

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Antonina Kolesnyk
O.V. Panchenko, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Definition of Cone Crusher Parameters

Cone crushers are high-performance machines. They are widely used in processing various rocks at all stages of crushing. They rank among the most important crushing machines. Their main advantage is the continuity of the action. Today, two cone crusher designs are widely used in the mining industry:

1. Cone crushers in which the main shaft is radially guided in the lower and upper parts of the main shaft bearing.
2. Cone crushers with an overhung head bearing at the bottom of the shaft and a flatter mantle slope in order to reduce the radial crushing forces.

Our research is related to a crusher of the first type.

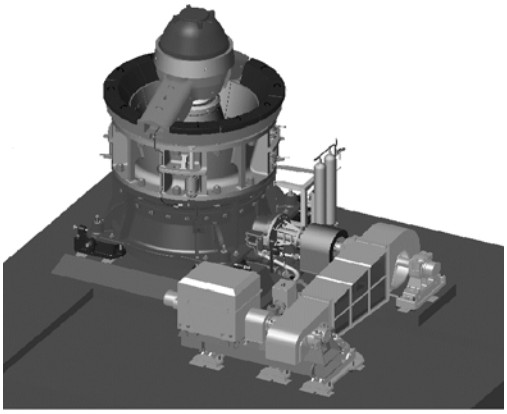
The crusher is designed for crushing ores, nonmetallic minerals and similar materials (except for plastic ones). The compressive strength of the crushed material should not exceed 250 MPa.

Our research is made on the basis of design documentation provided by Zaporizhzhya Iron Ore Industrial Complex. In the process of the plant modernization, a lot of equipment should be changed to a more powerful one. However, substitution of all equipment is not cost-effective. Therefore, the verification of crusher parameters in the changing operating conditions is required.

The main components of cone crushers operate in very difficult conditions. They are subject to high dynamic loads arising during crushing, and the effects of abrasive media. Therefore, the constructions have special requirements in terms of rigidity, strength and wear resistance. The shells, 'concave', conical crushing tool (mantle) and vertical main shaft are the most metal-intensive units of crushers and determine the overall reliability of the cone crusher. In this connection, checking the parameters is an actual technical task.

The task is solved in three stages:

1. Creating a 3D model with the help of the SOLIDWORKS programme, and checking the upper and bottom shells for static loads.
2. Carrying out loads and productivity calculations according to the initial and new parameters of the crusher.
3. Developing measures for safe operation.



Checking the computer model for loads and calculations of the main parameters show that the design of the crusher meets the specified safety margin.

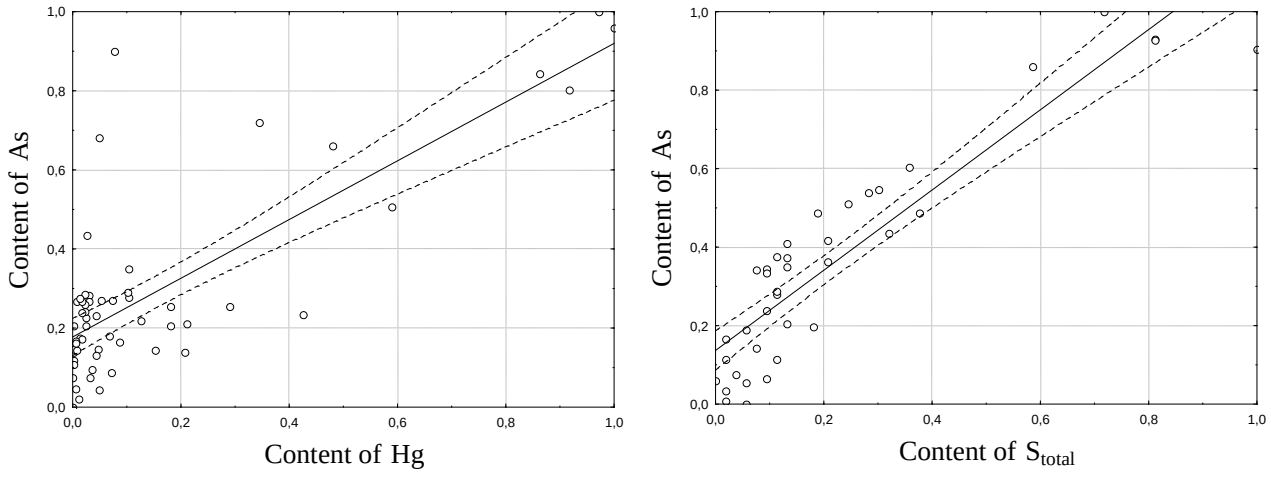
Yevhen Koziy
V.V. Ishkov, research supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Two-factor dispersion analysis in the study of toxic elements on an example of arsenic and mercury in the coal layer $c_6^н$ of the mine "Ternovska"

With the aim to determine the degree of quantitative influence of such factors as the content of ash and total sulfur in the coal and the thickness of the coal layer on the distribution of toxic elements, a two-factor dispersion analysis was conducted. If the calculated value of Fisher's criterion is greater than or equal to F critical (F_{cr}), then the distribution of toxic elements depends on the above mentioned factors, in the event that it is much higher than F_{cr}, then the factor is determinative. For the convenience of calculating the influence of each factors on the distribution of toxic elements there were determined coefficients that characterize the degree of influence of the individual factor. In order to do this, all factor dispersions were compiled, their sum is 100%. Part of the factor dispersion (from the total sum) is represented as part or coefficient which characterizes the degree of influence of the individual factor on the distribution of toxic elements. In calculating the two-factor dispersion analysis, the Excel 2016 program was used.

Content of arsenic on the layer $c_6^н$ of the mine "Ternovska" varies in the mine field from 29 to 280 g / ton. Arsenic forms the geochemical association with mercury (r = 0.78) and is related with content of total sulfur in the coal (r = 0.91). Linear regression equations are as follows:

$As = 0{,}1777 + 0{,}7423 \times Hg;$ $As = 0{,}0265 + 0{,}9573 \times S_{total}.$



a b

Fig.1: Line of regression between normalized concentrations As-Hg (a) and As-S_{total}. (b) in the coal of the layer $c_6^н$

Table 1

Values of coefficients that characterize the degree of influence of each of the factors on the distribution of arsenic

Factors	The value of the coefficient
Thickness of the coal layer	0.003
Content of ash	0.031
Content of total sulfur	0.966

The content of mercury varies from 0.04 to 3.7 g / ton. In general, it has been established in the mine field that mercury forms the geochemical association with arsenic (r = 0.78), which is related with the total sulfur content in the coal (0.60). Linear regression equations:

$Hg = -0.0868 + 0.8137 \times As$; $Hg = -0.0334 + 0.6648 \times S_{total}$.

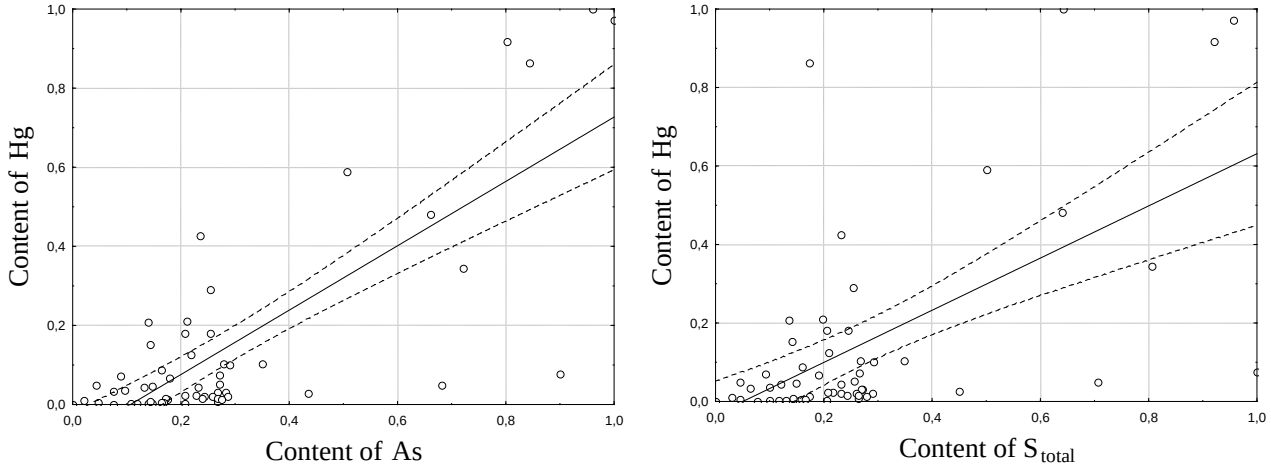


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Fig.2: Line of regression between normalized concentrations Hg-As (a) and Hg-S_{total}. (b) in the coal of the layer c_6^H

Table 2

Values of coefficients that characterize the degree of influence of each of the factors on the distribution of mercury

Factors	The value of the coefficient
Thickness of the coal layer	0.104
Content of ash	0.253
Content of total sulfur	0.642

To conclude, the obtained results of two-factor dispersion analysis confirm the high correlation between arsenic and mercury, as well as those elements with technological parameters of coal, which allows to increase the reliability of the results.

Maryna Kyznietsova
K.V. Kremneva, research supervisor
I.P. Nikitina, language advisor
National Metallurgical Academy of Ukraine, Dnipro

Mathematical Modeling of the Kinetics of Biomass Thermal Decomposition in the Process of Oxidative Pyrolysis

Modern ideas about the nature of the biomass pyrolysis process are based on the practical implementation and visualization of this process in laboratory or semi-industrial plants. Experimental data obtained under such conditions are the basis for most mathematical models describing the kinetics of thermal decomposition of biomass in the pyrolysis process. The process of pyrolysis of biomass is a complex of simultaneously occurring reactions with a large number of intermediate and final products. In this regard, today it is rather difficult to develop a model that takes into account all the reactions in the pyrolysis process, and also reflects the nature of the change in the composition of the intermediate and final reaction products. This fact, in turn, generates many approaches to modeling the process of thermal decomposition of biomass.

Modeling of kinetics of biomass thermal decomposition in the process of oxidative pyrolysis consists of several stages. In the first stage, reactions are selected which should be taken into account when the pyrolysis process proceeds. Today there are a number of different schemes for chemical reactions accounting, differing in the number and complexity of the reactions included in the scheme.

Depending on the complexity of the calculation performed, as well as the quality of the results obtained, the chemical reaction accounting schemes are consistently supplemented with the following conditions:

- the number of chemical reactions (from one to six reactions);
- taking into account secondary reactions of decomposition of resins;
- taking into account the thermal effects of pyrolysis reactions.

According to the literature analysis, as well as the conducted experimental studies of the process of oxidative pyrolysis, it is established that the type of biomass used has a significant influence on the course and main indicators of the process. The yield of resins during pyrolysis is significantly affected by the temperature, as well as by the residence time of the resins in the hot coke layer.

The mathematical modeling of the kinetics of biomass thermal decomposition in the process of oxidative pyrolysis is based on the use of a multi-stage decomposition scheme for the chemical components of biomass, implemented taking into account the residence time of the resins in the hot coke layer and the layer temperature shown in Fig. 1.

The multi-stage scheme of thermal decomposition of biomass is shown in Fig.1.

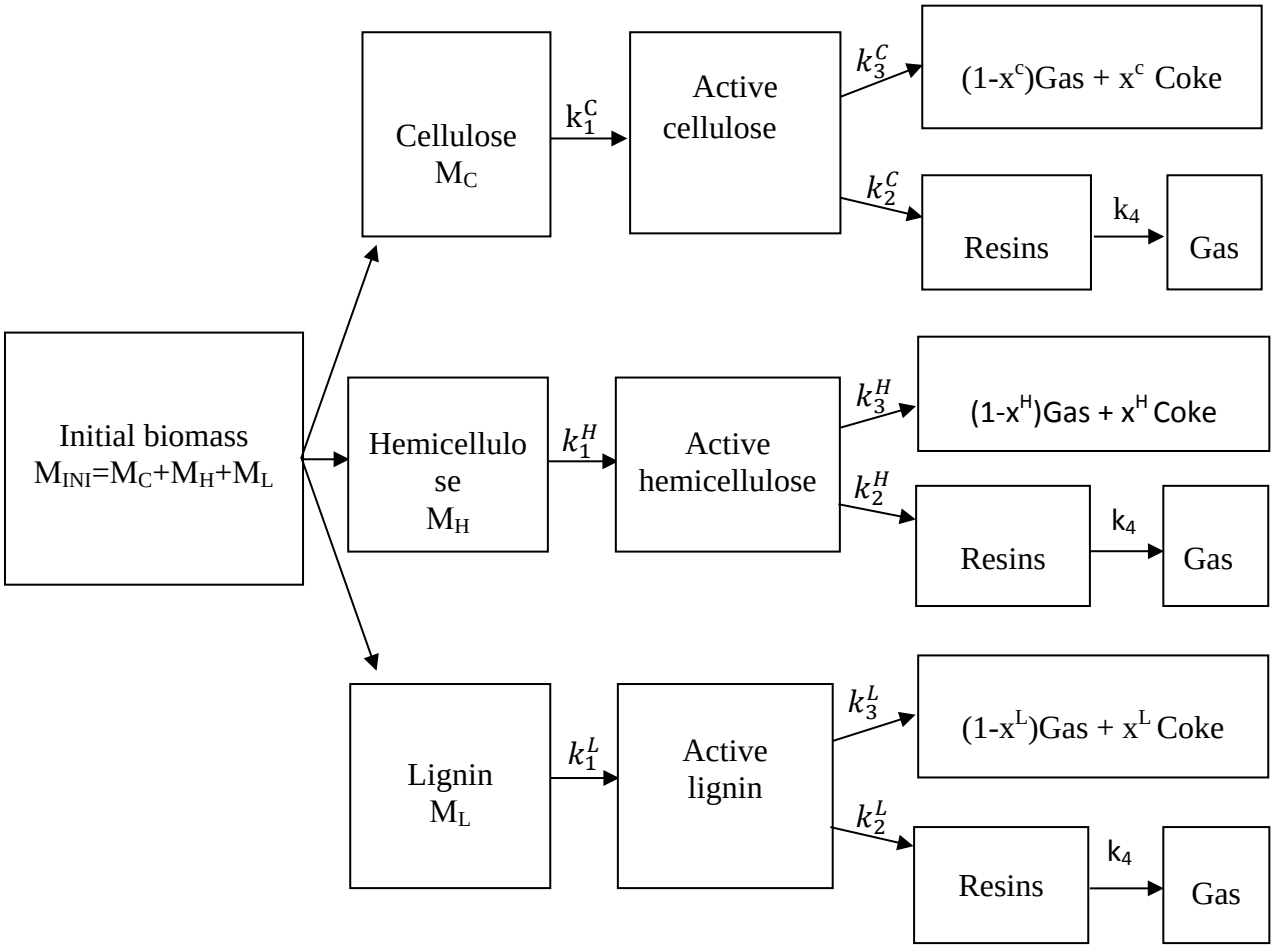

Fig. 1. Multistage scheme of thermal decomposition of biomass

$k_1^C, k_2^C, k_3^C, k_1^H, k_2^H, k_3^H, k_1^L, k_2^L, k_3^L$ и k_4 - the values of the rate constants for the corresponding thermal decomposition reactions are determined in accordance with the Arrhenius law:

$$k_{\text{i}} = k_{0_{\text{i}}} \cdot e^{-\frac{E_{\text{i}}}{R \cdot T}}$$

where $k_{0_{\text{i}}}$ – pre-exponential factor (determined experimentally), 1 / s;

E_{i} – activation energy, J / kmol;

R – universal gas constant, J / (kmol · K);

T – temperature of biomass, K.

x^C, x^H, x^L – values of mass coefficients of coke formation.

This scheme is universal and allows modeling pyrolysis process for any kind of biomass taking into account the thermal effects of chemical reactions of decomposition of the main biomass components, which will allow determining the total thermal effect of the pyrolysis process as a whole.

Maksym Matsukevych
Yu. A. Gichov, research supervisor
I.P. Nikitina, language adviser
National metallurgical academy of Ukraine, Dnipro

Classification of Pulsator Jigs in Energy and Technological Processes

The experience of pulsation application testifies its high efficiency, which is manifested in a noticeable improvement of energy, technological and environmental indicators of processes. For example, the positive effect of pulsations during fuel combustion is due to the intensification of the mixture formation of fuel and air. Due to the improved mixing of the gas-air mixture, the fuel burn-up is reduced compared to conventional stationary combustion, which leads to fuel economy and a reduction in harmful emissions to the atmosphere.

Devices for pulsations excitement of (pulsator jigs) can be divided into three main classes: acoustic, gasdynamic and mechanical. Classification of devices and the principles of their work are illustrated in Figure 1.

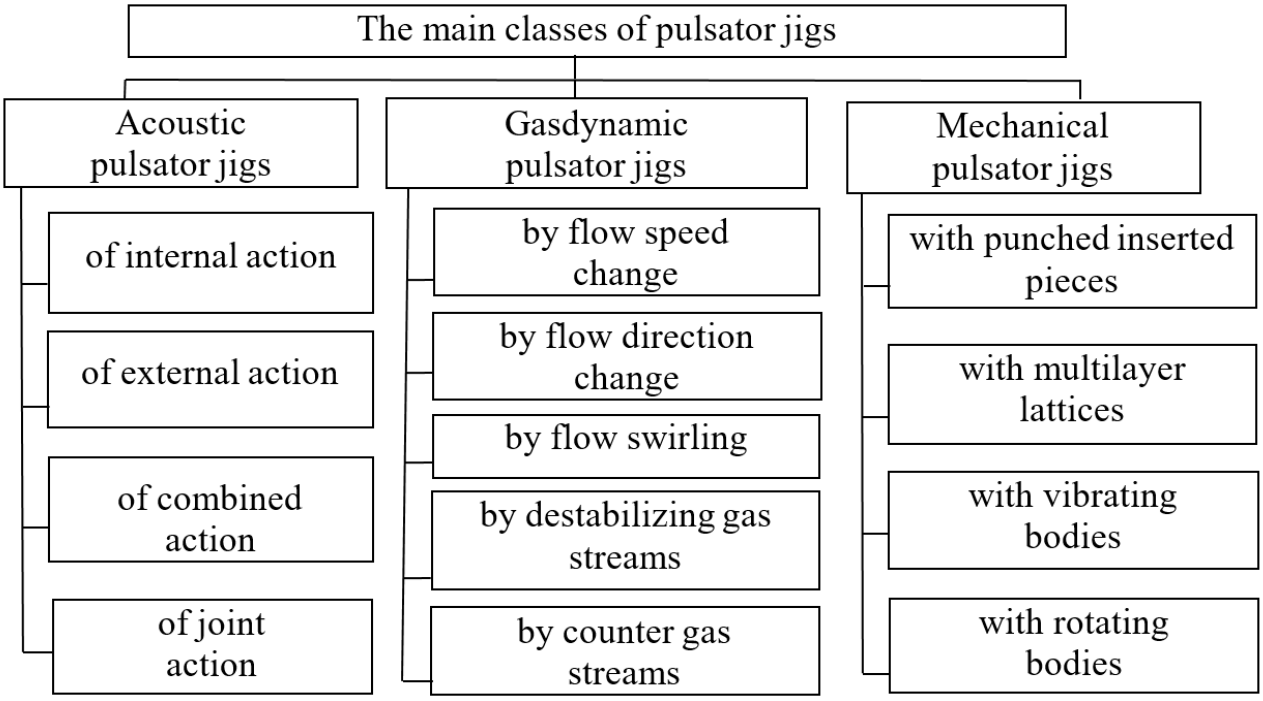

Figure 1 – Classification of pulsator jigs and principle of their work.

In acoustic pulsator jigs of joint action, sound generators in the burner device and outside of it work simultaneously. In all cases, acoustic pulsator jigs produce an indirect influence on burning process without changing cardinally gasdynamic picture of the process. This limits the influence of pulsations on burning process.

In gasdynamic pulsator jigs, the effect of pulsations substantially depends on characteristics of gas flow, for example, on the direction of a flow, the speed of the

gas, pressure and other. It seems to be quite a complex challenge to provide the ranges of frequencies necessary to setup on resonance frequencies as a change of characteristics of a gas flow can result in loosening or disappearance of pulsations. Gasdynamic pulsator jigs work stably and effectively in the strictly given mode of gas flow which excludes frequency tuning by the change of the mode.

In mechanical pulsator jigs the punched insertions, multi-layer walls, and the vibrating bodies also don't give the chance to regulate resonance frequencies of pulsations. Insertions and multi-layer walls are fixed which excludes frequency change of pulsations of gas by their relocation.

Influence of the vibrating bodies on a gas flow is very restricted, owing to the limited amplitude of vibrations. In this regard vibration of bodies influences a gas flow indirectly without sharp change of gas characteristics.

The contrasting changes of gas characteristics necessary for pulsations are possible by a periodic cutoff of gas. The periodic gas cutoff can be provided with the mechanical pulsator jigs rotating with a certain frequency.

The modification of the rotating pulsator jig with the cylindrical breaker is illustrated in Figure 2.

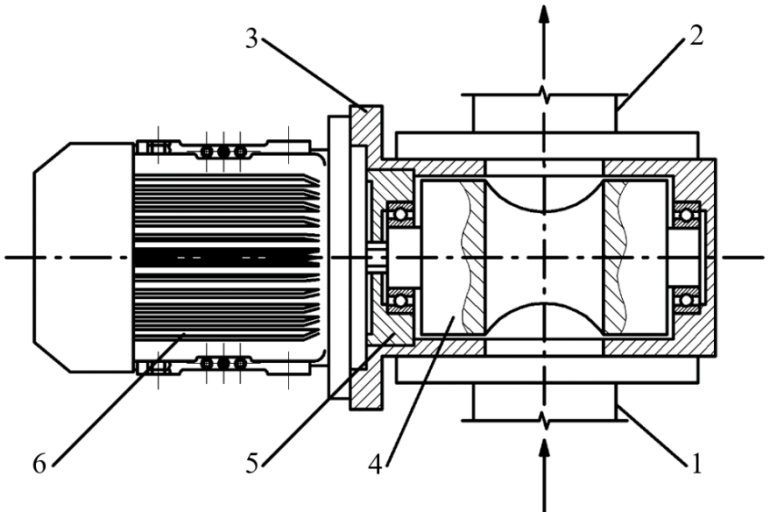

Figure 2 – Mechanical pulsator with cylinder interrupter of gas stream
1 and 2 – entry and exit of gas (air); 3 – pulsator jig body;
4 – rotating cylinder interrupter;
5 – cage; 6 – motor body.

The analysis of devices for pulsations excitement allows us to select the mechanical rotating pulsator jigs which by frequency change of rotation regulate the frequency of pulsations and, respectively, provide pulsator tuning jig on resonance frequencies.

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Dmytro Mazhuga
E.V. Panchenko, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Actuality and Justification of the Choice of a Roller Crusher Drive Parametrs

Crusher roller is a concentrating crushing equipment provided with the dentate segment rolls fixed on them, having the form of a polyhedron rigidly planted on the shaft. Roll crushers are widely used for fine, medium and small grinding of various rocks, food products and chemical materials (clay materials, chamotte, quartz, spar etc.).The main working element of the roller crusher is a cylindrical roller rotating on a horizontal axis. The material to be crushed is fed from above, tightened between the rolls/roll and the lining of the crushing chamber and, as a result, is crushed.

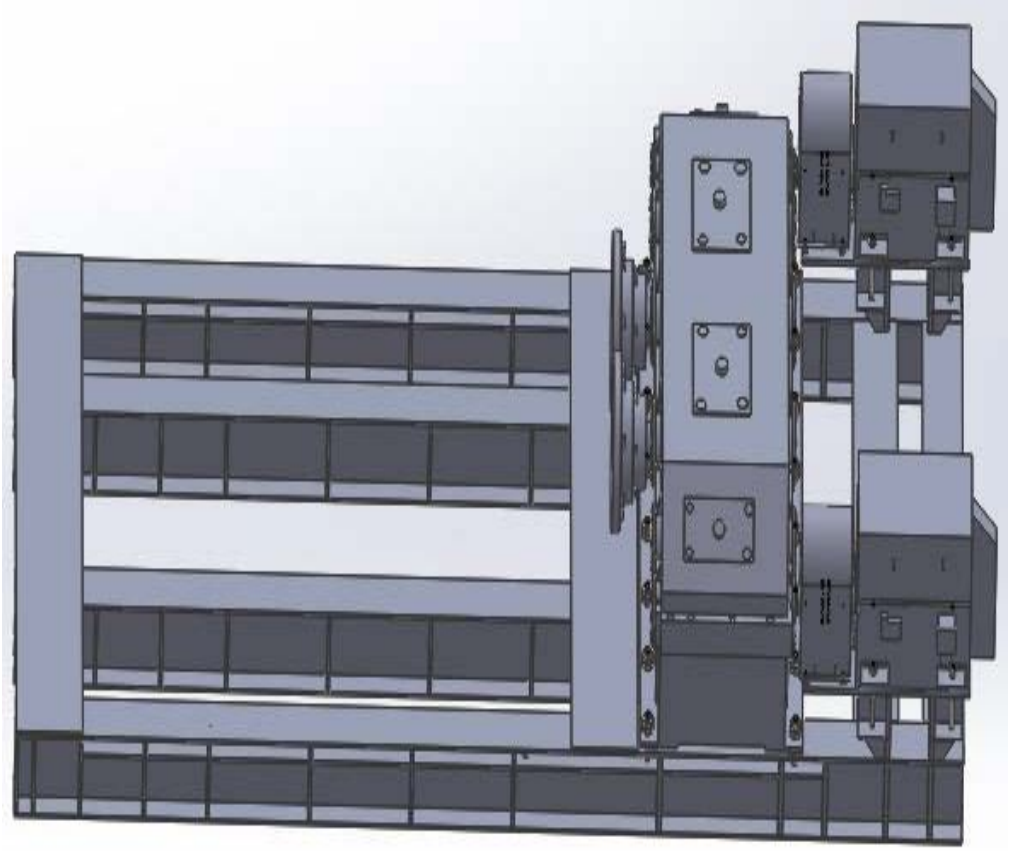
The principle of operation consists of crushing the material, in part by abrasion, impact or bending between two parallel cylindrical rollers rotating towards each other at the same speed.

Actually, crushing, in most cases, is the main and often the most energy-intensive operation, designed to break down raw material to the required size, as well as to uncover mutually intergrown aggregates and to form particles of individual materials. Currently, coal is enriched in concentrators that use technically possible equipment. The development of more economical and productive methods of coal enrichment at its various stages is very valid.

When operating a crusher, the main danger is represented by its rotating parts: friction pulleys, drive belts, as well as loading units for crushing material and unloading crushing products, electrical equipment, and hydraulic drive.

During the graduation project, the drive parameters of this crusher have been determined and selected. A calculation has been performed to determine the productivity of the crusher. Verification calculations of couplings and the choice of the electric motor have been made. A computer model of the crusher drive has been developed. According to the received drawings, in the SolidWorks programme, model parts have been built, of which assembly units of the drive have been assembled.

Designs for which there were sheets of installation drawings or specifications have been collected using views in the drawings of neighbouring levels. As a consequence, when developing the computer model for driving the crusher, errors have been identified.



Reengineering included the analysis of drawings and organization of the workflow at the enterprise. One of the most important tasks of engineering is the process of developing design documentation.

From the analysis of the drawings it is evident that the creation of a model and working drawings is carried out in different software products. The result of this scheme is a lot of design errors, revealed in the process of creating three-dimensional models of parts and assemblies according to factory drawings.

As a result of our research, the drive parameters have been determined, a computer model has been built and a set of design documentation has been compiled. The actuality of the crusher in the mining industry has also been proven. Thanks to the analysis of these factors, it is possible to significantly improve the productivity and economic factors of production. Dangerous and harmful production factors in the crusher operation have been considered.

Oleksiy Mutyanov
A.A. Martynenko, research supervisor
V.V. Zabolotnikova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

5 useful properties of smartwatches

Nowadays a lot of scientific researches claim that modern gadgets have a negative impact on people, children, adolescents, society as a whole. Among the leading there is aggression in children, negative impact on the brain and blurred vision. Actually, we do not need researches. Every day we can see a person walking on the street wearing headphones, totally absorbed by their smartphone. And we see how people got into trouble because of it as well. But more people we even can't see, because they stay home affected by their gadgets.

But despite all the negative sides, it's foolish to deny that many modern gadgets make our lives much easier, enabling us to do routine tasks much faster or even help in non - standard situations. One of these gadgets are smartwatches. These gadgets are far from perfect: most have a weak battery, and many of their owners can't find any real use for them. So what are the useful functions of a smartwatches? Here are five of them.

1. Fast access to information

To get information on the smartphone, you need to go through a whole ritual: get the device from your pocket or bag, unlock it, launch the application... Smartwatches are more convenient, because they are always under your hand. No, actually, they are on your hand. Thanks to complications, we can get any information just by looking at the clock screen. This means that you just have to raise your hand, and you will see not only the time and date, but also the weather, the number of passed steps, promotions, events in the calendar and so on.

A good example is the iTranslate application. Right on the dial it shows the most common phrases in the language zone where you are. If you arrive in Berlin, the watch will begin to display common phrases in German with a translation to your language. At lunchtime they show how translate the phrase "Bon appetit", and near the end of the day they remind you how to say good night.

Also you can not be afraid to forget something. It's just necessary to raise your hand to see a reminder "buy bread after classes." And you don't have to keep a schedule in your head. Or check it in the university's website every time. The clock can easily remind that you have a history lecture in half an hour in the room 32.

2. Smart alarm clock

How do usual alarms work? They wake you up at a fixed time, not considering the phase of sleep. And setting an alarm clock on a smartwatch at 7 a.m., may result in waking you up at 6:30, but you will feel much more alert than if you woke up at 7.

It’s because they noticed the phase of fast sleep and wake up you only during it. It works like magic.

3. Fitness tracker

Moreover, the device has rate monitor and monitors physical activity, determining whether you are walking, climbing up the stairs or just sitting at the desk. In the latter case, the watch can remind you to get up and knead your muscles every hour. They show how many times you warmed up during the day, how many calories were burned while moving and how many minutes you were actively engaged in exercises.

4. Control panel

Smartwatches are a perfect gadget for managing everything - from the player on the phone to the TV and smart home. You no longer need to have a remote control from the TV, which is always lost. Manufacturers of cars also could not pass by this staff. With its help you can find your car in the parking, block and unlock the doors, check the fuel level or charge of the battery on the electric car, adjust the temperature in the cabin and so on.

5. Hands-free

Smart watches can help, for example, in busy places or when driving in cars, when you can’t use the phone. With the help of voice assistants, you can easily call, send messages, put reminders, translate phrases, learn stock prices, and even send messages via third-party instant messengers. For example, the phrase: "Send a message to Vanya in the Telegram: I'll be in half an hour" will be understood and processed by the watch. Of course, you should have internet on your paired smartphone as well as Telegram.

Obviously modern devices can have a negative impact. But no one can decide how to use it except for you. The result depends on the way the one is used: for someone a smartwatch is a simple "notifinder", but other users squeeze out the maximum of available applications.

Illia Olishevskiy
G. S. Olishevskiy, research supervisor
L. A. Zaika, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Analysis Of The Use Of Heat Of Powerful Turbochargers For Heat Supply Systems Of Buildings

At present, one of the most pressing problems in the world and in the country is the problem of energy saving. This problem is caused by the fact that energy consumption is increasing, the reserves of the main fuel and energy resources of natural origin are decreasing, the production and use of energy are not efficient enough, and the adverse effect on the environment is growing. It is necessary not only to consume less energy, but to use it more fully in each specific case, minimizing inevitable in any technical process emissions into the external environment. That is, energy efficiency is an indicator of the country's scientific, technical and economic potential. There are various powerful power plants, in which there are significant emissions of thermal energy into the environment. These are condensing power plants, high-power power transformers, powerful air-conditioning units for mines and large facilities, as well as other high-energy installations and systems. On these facilities technical solutions for the utilization of thermal energy released into the environment, either have been developed or are being developed. Typically, this energy is used for local heating and hot water supply systems. Various methods, including non-traditional ones, are used, such as the use of heat pumps, solar units and other equipment.

Therefore, it was decided to analyze the possibilities of various methods of heat recovery at such high-power installations as air turbochargers of mines. In the currently used turbocharger cooling systems, all heat received by the cooling water is discharged into the environment. The amount of heat removed can reach up to two or more MW. At the same time, these plants have practically a 24-hour operating mode, which is important for the functioning of the heating system and hot water supply.

As the investigated object, the air turbocharger K-500, widely used in mines, was chosen. When air is compressed in the turbocharger stages, its temperature rises substantially. In turn, further compression of air at elevated temperature leads to unnecessary additional costs of drive power of the compressor. Therefore, intermediate cooling of the compressed air is used between the turbocharger sections. The water cooling system of the K-500 turbocharger consists of two intermediate and final air coolers in which the cooling water is heated to 35 ° C in accordance with the required final temperature of the compressed air. Since the air temperature during compression in the turbocharger stages reaches 90 ... 100 ° C or more, it was decided to divide each air cooler into two parts. Where in the first part it would be possible to heat the water to the required temperature using only a part of the heat removed in the air cooler. In turn, in the second part of each heat exchanger, the compressed air is finally cooled to the required value of 40 ° C.

Thus, using the developed automated technique, the possibility of consecutive heating of cooling water in the first parts of all three air coolers was analyzed and the

intermediate water temperatures between the air coolers corresponding to the maximum heating power of the heating system (570 kW) were determined, which corresponds to more than a quarter of the total heat removal. This scheme proved to be more advantageous than the water heating scheme first in the first intermediate air cooler, followed by heating in parallel in the two remaining air coolers. In this case, a rational intermediate temperature of water between two heating stages was determined. However, the resulting heat output turned out to be a quarter less than in the sequential heating scheme in three air coolers. At the same time, no additional energy resources are spent in these schemes.

The possibilities of using a heat pump in the system under consideration were investigated. Heat pumps are widely used for heat supply, as well as air conditioning of residential and administrative buildings in various countries and are becoming increasingly common in Ukraine. The principle of the heat pump is to take heat from various low-potential (low-temperature) energy sources with the subsequent transformation into high-temperature heat energy and transfer it to the consumer. At the same time, energy is expended on the drive of the heat pump compressor. In our case, a low-potential energy source is the heated cooling water, the temperature of which we can take in the widest range.

A sequential scheme for connecting the heat pump to the heated water flow of the cooling system of the turbocharger was considered. In this case, cases were studied for different values of the temperatures of the water entering the evaporator of the heat pump from the three air coolers simultaneously. Having analyzed these options with the help of an automated methodology implemented in the Mathcad environment, the growth of the heating capacity of the heating system with the decrease of the temperature of the heated water at the entrance to the heat pump was determined, as this increased the water consumption in the system and, correspondingly, the thermal energy obtained in the air coolers was increased as well. However, at the same time, the energy costs for the compressor drive in the heat pump (more than 0.5 MW at the water temperature at the entrance to the heat pump 30 ° C) increased substantially. Therefore, it was decided to stay on the option with a water temperature of 65 ° C, which corresponds to a heating power of the heating system about 1 MW and, correspondingly, 92 kW compressor drive power. That is, the use of a heat pump in the heat recycling scheme of an air turbocharger makes it possible to practically double the thermal capacity of a building heating system with a relatively low energy cost for the drive of a heat pump compressor. But the application of the scheme for heat recovery without a heat pump does not require additional energy costs while ensuring a significant heating capacity of the heating system. Thus, due to the utilization of the thermal energy of the cooling system of the air turbocharger unit, it is possible to supply the heating system and hot water supply for both the administrative and everyday buildings of the mine and other structures with thermal energy. At the same time, existing boiler houses can act as a reserve in case of an emergency.

Daria Parshkina
V.I. Mieshkov, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Machine's Vision And the Fields of Its Application

We receive most of the information about the external world around the human with the help of our vision. Further, this information is processed with the help of the mechanism of analysis and interpretation of visual information. Therefore, in the twentieth century a question about the possibility of machine implementation of this process is in question. Machine vision is a necessary component of modern technologies. This element is one of the most promising methods to automate actions with the use of computer technology and robots. Machine vision systems involve the conversion of data received from the image capture devices, and further operation on the basis of these data.

Currently, the machine vision is widely used in medicine, robotic technology, automobile industry and in military sphere. These industries have well-defined tasks for computer vision that are used by leading research centers and companies. For example, machine vision plays an important role for military drones, because the recognition of objects with the help of a computer is necessary for the observation and reconnaissance missions. Such drones are equipped with high-precision sensors and cameras. They can fly autonomously, conduct reconnaissance, surveillance, detect improvised explosive devices and work together with aircraft.

The field of machine's vision application is very wide. These technologies can be used almost in all spheres of life. Due to the increasing complexity of scientific and technical problems, automatic processing and analysis of visual information are becoming more urgent issues. Many analysts believe that the success of modern business is based mainly on the quality of the products which are offered. Intelligent cameras as well as innovative software are used to check the quality of the products.

Machine vision is a must in situations that involve risks, especially when a lot of date are processed. Today, developers in the area of computer vision solve difficult tasks. World leaders in the field of science are trying to design a universal self-learning system that would develop itself in the same way as it happens with a person.

Machine vision can help robots to achieve unprecedented results and develop great power ahead of human thinking.

Yuliia Petrushko, Constantine Bazilo, Vasyl Zaika
C.V. Bazilo, research supervisor, language adviser
Cherkasy State Technological University, Cherkasy

Mobile Ultrasonic Surgical Instrument

The world is full of dangers such as criminalization of society, terrorist threats, military conflicts and civil unrest. Recently, these dangers are often accompanied by gunshot wounds.

The rapid development of new weapons increases the number and severity of gunshot injuries. Any injuries, including gunshot ones, are followed by soft tissue infections.

The use of antibiotics (Fig. 1) can partially prevent the spread of infections. But their frequent use leads to changes in microflora and reduction of antibiotic therapy effectiveness.

Negative aspects	Positive aspects
changes in microflora	*prevention of soft tissue infections*
reduction of antibiotic therapy effectiveness	

Fig. 1. Use of antibiotics

The main method of prevention of serious infectious complications of gunshot wounds is a primary surgical treatment of wounds.

Development of methods to reduce blood loss, wound healing acceleration and resorption of postoperative scars is one of the biggest challenges in medicine, which ultrasound helps to solve.

Our solution is the Mobile Ultrasonic Surgical Instrument (Fig. 2). The project participated in the competition of engineering start-ups Vernadsky Challenge and entered the TOP-10.

Fig. 2. Mobile Ultrasonic Surgical Instrument Prototype

Ultrasonic instrument does not stick to the tissue and the surface of the wound channel and does not cause additional injuries. It also has such advantages as reduction of wound healing time and self-sterilization ability.

Removable Li-ion batteries will be used to ensure the mobility of the instrument. Our ultrasonic surgical instrument will also have a system for disinfection of operating part in extreme conditions.

The handle of the surgical instrument will have all basic control elements for ease of use and simplicity. Active elements, made from high quality piezoceramics, will be used to ensure reliability.

There are no direct competitors in the Ukrainian market. Analogues from other countries include, for example, ultrasonic scalpels, produced in the USA and Germany.

Their main disadvantages are cost and large size (Fig. 3). Our instrument is mobile and can be used in extreme conditions of military medicine and also in surgical departments and clinics.

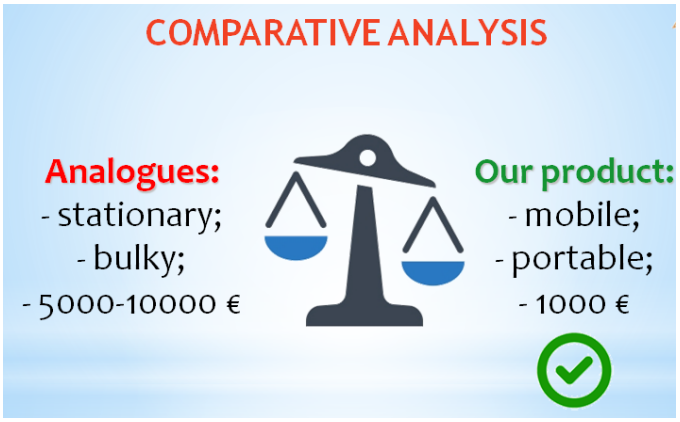


Fig. 3. Comparative analysis

This work is made within the framework of the scientific project "Development of mobile highly efficient ultrasonic surgical instrument for military and civil medicine" which is carried out at the Department of instrument making, mechatronics and computerized technologies.

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Daniil Shapoval
A. A. Martynenko, research supervisor
V. V. Zabolotnikova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Why are electric motors our future?

Today we are no longer surprised by the electric motors. At the end of last year the general park of electric vehicles which are in operation in Ukraine has already exceeded 4000 units. With the big Tesla company as an example lets consider the perspectives of electric motors for Ukraine.

What comes to your mind when you hear Tesla?

Tesla is a large company that deals not only with the production of different machines, but even with their launch into outer space. Tesla is actively engaged in researching and creating electric motors for cars and homes. Tesla in the coming years will be able to implement electric motors in all aspects of modern life.

Let's take for example *Tesla Roadster, an* absolutely innovative car.

A roadster (spider or spyder) is an open two-seat car with emphasis on sporting appearance or character. And Tesla showed her vision of the roadster at the presentation. It is a completely new sport car that can be compared with cars of premium class. Zero to 60 mph could take as little as a mind-bending 1.9 seconds. - Zero to 100 mph is being accomplished in just 4.2 seconds. This is equal to the speed of the most expensive sport cars in the world. Tesla also claims a 620-mile range on its 200kWh battery pack. But this is only a concept and we will be able to see the car on the roads only in 2020.

There used to be electric cars, which were enough for a trip on short distances. Now Tesla actively promotes this idea in all spheres of mechanical engineering. We will soon see a truck with a record high charge and a supercar with the highest charachteristics.

In 2017 more than 1.2 million electric vehicles and plug-hybrids were sold in the world, compared to 2016, the growth in these segments of the car market was 57%. Electric cars are the future of the whole world, and Tesla is one of the companies that deals with investments in this field. What makes the situation even more specific it is the price of gasoline that is too high for Ukrainian car owners. What is more taking into account environmental legislature that moves to more strict regulations we can conclude that electric cars is one of the most possible solutions.

Nikita Marchenko, Kirill Shelipov, Daniel Oliinyk
A. A. Martynenko, research supervisor
L. A. Zaika, language supervisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

CNC Cutting

Computer numerical control (CNC) is the automation of machines with the help of preprogrammed computer control commands. Milling machines with numerical program control (CNC) are equipment intended for the machining of various sheet materials by means of a special tool - milling cutters.

What is CNC machine and what is it used for? CNC machines are used for threading on various materials, for example wood, aluminum, iron and even steel. Processing takes place with the help of a special tool - the cutter. Cutters are metal tools of various shapes with several cutting teeth. The shape of the milling cutters is conical, cylindrical and other types. The material from which the cutting part is made must be much stronger than the processed material. That is why solid steels are selected for mills, mineral ceramics or even diamond can also be used. Rotating at high speed, they process the material, cutting, drilling and engraving it in accordance with the specified program under the control of the CNC operator. Depending on the location of the tool, milling can be horizontal or vertical. Universal machines have become very popular, making it possible to milling complex parts from any angle using different cutters.

The cutter fixed in the collet is the main element in direct contact with the material being processed. The collet with the milling cutter fixed in it is installed in the spindle, which ensures the rotation of the milling cutter. In turn, the spindle with the milling cutter is mounted on a movable beam-a portal that moves the spindle and cutter in three axes of coordinates over the material being processed, mounted on the working table. The movement of the portal, as well as the movement of the spindle through the portal, is provided by three micro-step motors. The portal, bed, motors, spindle and cutter are the mechanical part of the milling machine. Each engine provides the movement of the portal and the spindle on its axis according to the specified program.

The control stations of CNC milling machines are an electronic part of the equipment. The machine software processes vector images from graphic files, translates them into G-codes that control the operation of micro-stepping motors. So, for the manufacture of a particular part, it is necessary to build it in the graphical editor of a computer program such as Auto Cad or Corel Draw. After installing the developed program in the RAM of the machine (random access memory), the operator can start working, having previously selected the necessary modes and parameters in accordance with the assigned technological task and the material being processed.

Numerical software control allows to automate complex technological processes for processing of various materials. The CNC machine in the process of

operation does not require any complicated operations from the operator. The machine runs according to the program laid in it before the processing begins. Entering the program is carried out by the operator from the console, designed to control the machine in manual mode. In the event of an emergency, the remote control is used to turn off the machine. All current information about the machine's operation is displayed on the operator panel, which visually monitors the execution of technological operations.

But the program that is used is written by the programmer. This is why this topic has become interesting to us. First of all, the operator must do certain actions in the program. The work of the entire CNC machine depends on how this program will work. Therefore, the role of the programmer in this matter is the most important. As described above, before processing the material, many operations are performed in various programs. That's why this topic is so closely related to programming. The algorithm by which the program determines how the machine will process the material depends on the code of the program. The task of writing code is the task of the programmer. This example demonstrates the connection between mechanics and software in the present, and in the future too.

Milling machines have quite a lot of pluses, among them:

- ✓ the ability to produce a variety of products from completely dissimilar materials (which can’t be processed in any other way);
- ✓ accuracy and evenness of the cut, so that the product turns neat and beautiful;
- ✓ the ability to make the desired shape, depth and even shaped cuts;
- ✓ the work can be carried out both on a vertical, horizontal, and inclined surface;
- ✓ high speed of work;
- ✓ a wide variety of details: flat, bulky, and even 3D;
- ✓ repeatability of more products, which is almost impossible with other processing methods;
- ✓ the ability to cut, make a rough calibration, milling grooves and other types of connections used in the assembly of the product.

CNC milling machines are high-tech modern equipment that can provide excellent material processing quality. Using CNC machines increases the level of security and does not require virtuosity and high professionalism from the operator. But at the same time, CNC machines are an excellent zone of activity for programmers who provide software for these machines.

Mariya Shepelenko
O.V. Zamyckiy, research supervisor
N.O.Holiver, language adviser
"Kryvyi Rih National University", Kryvyi Rih

Analysis of apparatus for industrial air preparation and purification

In the modern mining industry fairly sophisticated equipment of pneumoseparation, which involves a large number of elements are used. The equipment for mechanization uses compressed air, the quality of which significantly affects the efficiency.

Poor quality of air leads to several problems in the operation of pneumatic equipment, so that the air preparation at all stages of use, is an important task for the mining industry.

Having analyzed the work of leading scholars in the filed of mechanics, environment, and separation of disperse systems it can be concluded that the existing equipment for separation and catching impurities in the gas environment can be divided into the following types, namely, apparatus for the deposition, under the action of gravity; under the action of inertial forces; the influence of electrostatic forces; filtering machines and apparatus for the wet cleaning. More generally, these devices can be divided into two types of machines for dry and wet gases cleaning.

As you know the basic working principle of *dry cleaning machines* is the separation of polydisperse dust parts from the gas stream under the action of gravity. This principle is the main in a dry inertial gas cleaning device, as self-cleaning filters, oil filters, and the filters of the collar.

Self-cleaning filters are most common in shaft of turbo compressor units. Experience of filters operation of this type in winter conditions showed their major drawback, low temperature of primary air (especially heavy snowfall), the filter quickly becomes clogged and nipped. The movement of the blind scrapers and the pressure drop sharply increases. It is possible to solve the problem by using oil with a low pour point, or to carry out heating bath temperature below 5-10 °C. But this solution is not advisable, as it increases the cost of oil change and energy used for heating [1].

Metal oil filters can be attributed to auxiliary equipment of the compressor station. Such filters are used for medium and fine purification of raw air. The principle of operation of such devices is catching dispersed impurities by precipitation under the action of gravity on the oil film nozzle [2]. But as practice shows, this design of filter has several disadvantages: it does not provide a fine purification of raw air when the size of the parts is not more than 2 mm; the additional costs of viscous oil, which it is necessary to change from time to time and reduce the cleaning efficiency during freezing oil in the filter.

As described above, the atmospheric air holds the dust and other mechanical impurities. These particles pollute the channels of compressor equipment and lead to wear of the seals. To increase service life and reliability of the compressor apparatus of clean source of *air through porous filters* are used. Their job is to clean up the air by passing it through the nozzle to the wet filler [1]. Of course, the purifying ability

of such device decreases and the necessary regeneration of the filter is needed. This is a significant drawback, which leads to additional costs for oil changes and carries loss of time for cleaning.

The feasibility of using *wet apparatus* is usually determined by the need for simultaneous cooling, trapping fog and spray, the absorption of gaseous impurities, etc. Wet gas cleaning has a number of advantages over dry, namely: relatively low cost; higher efficiency of particle collection (purification of gases from particles to 0.1 microns); these devices may be used as heat mixing exchangers [3]. Capture impurities and cooling in such devices takes place directly by contact of air with irrigated water, so this system is also called contact.

The scrubbers. Countercurrent scrubber (gas scrubber) has a variety of content; it can be bodies in different geometric shapes. Such content forms a nozzle scrubber. This type of equipment is used only for catching dust, which is well moistened. The use of such a scrubber is appropriate in cases where the process of catching dust is accompanied by cooling of gas or absorption [4].

Foam dust collector. These devices began to be used with the need for more intensive interaction between gas and liquid flows. Cleaning processes in such units are held by processed by making highly turbolized foam in which the continuous destruction is held in the form of the merger and the formation of new bubbles. In many designs the foam dust collector, a foam stabilizer is provided. It needed to dramatically reduce the water consumption of the splicing apparatus. The principle of operation of such devices is similar to the purification of gases in a scrubber. The only difference is that dust and gas flow passes through the foam layer, which catches particles of dust.

Venturi Scrubbers. Venturi scrubbers are effective wet dust collectors. As the name implies a common design feature of these devices is the content distribution pipe, which goes directly to the crushing process of the moving fluid stream of the contaminated air to a velocity of 150 m/s, with subsequent use of the droplet separator. In conclusion, the analysis of gas-cleaning system, which occupies an important place in the preparation of air for pneumosuspension of mining equipment, needs a detailed investigation. The further use of the air that has been cleaned in the apparatus for wet cleaning, require additional training, namely the separation of the excess of air fraction. It is expedient in this case to use centrifugal drop catcher.

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Igor Shevchenko
S. I. Fedorov, research supervisor
L.A. Zaika, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Geothermal energy

For a long time man needed energy. In primitive society, the only source of energy was fire. But humanity has developed. Man began creating yet simple devices for obtaining energy. In the period from the 5th to the 17th century, people actively used the energy of wind and water. In the 17-18 centuries, the development of a new type of power engineering - heat-and-power engineering was started. Later, steam engines, internal combustion engines, steam and gas turbines appeared. In the 19th and 20th centuries, there was a rapid saturation of industry with power machines. Tens of thousands of power plants were built. The man got access to the giant storehouse of non-renewable energy - coal, oil, gas. A lot of mines, oil - and gas pipelines were built. Energy consumption has increased. Especially energy consumption increased in the twentieth century (12 times). Unfortunately, the reserves of oil, gas and coal are by no means infinite. To create them, nature took millions of years, and they will be spent hundreds of years. Today, the world began to seriously think about how to prevent the predatory looting of earthly riches. Only with this condition, fuel reserves can last for many years. However, as is known, the resources of organic fuel are reduced as they are developed by billions of tons per year. At the current level of energy consumption, oil should be sufficient for 50 years, natural gas - 73, coal - 170, brown coal - 500 years.

Many scientists and engineers are engaged in the search for new, unconventional sources of energy. In 1978, the resolution of the UN General Assembly introduced the concept of "new and renewable sources of energy".

The potential of NRWE (Unconventional renewable energy sources) of the planet is extremely large. In one of the projected scenarios for the development of world energy, developed by the American company Shell International Petroleum, it is asserted that by 2030, up to 20% of all world demand for commercial energy can be met through EEVE. In the following period, this figure can reach 66%, whereas at the present time, about 5-6% of the world's primary energy needs are covered by the NRTI. Geothermal energy is just one of the types of NERs. When using traditional energy sources, the world is faced with a number of problems:

- Inconsistency of energy resources with consumption;
- Continuous deterioration of energy value and quality of extracted energy resources;
- Deterioration of mountain-geological and climatic conditions in the areas of development of new fuel deposits;
- Continuous growth of environmental pollution as the scale of energy consumption increases.

From all of the above, it can be concluded that the future is for non-traditional and renewable sources of energy, to which Geothermal energy belongs. The prospects for using this type of energy are great. The geothermal energy of the Earth as a whole is estimated at a power of about 32 TW. Geothermal resources of the world that are

available for use are estimated at 140 GW. So far, these resources have been developed very little.

Geothermal energy is the energy contained in the bowels of the earth. It belongs to the category of renewable energy sources and is the most accessible, as if prepared nature for direct use. There are five types of geothermal energy deposits in the world:

1.Steam thermostats (deposits of steam and self-pouring steam-water mixture).

2.Hydrotherms (deposits of self-pouring hot water).

3.Thermoanomal zones (heat deposits having an elevated gradient in water-saturated permeable rocks).

4.Petrogeothermal zones (zones that have low-water and low-permeability rocks heated at sufficiently high temperatures at accessible depths).

5.Magma (molten rocks heated up to 1300 degrees).

Currently, practically the only source of geothermal energy are steam-hydrotherms and hydrotherms. They are used both for obtaining electric energy, and for obtaining thermal energy.

Certain prospects are associated with petrothermal energy sources, the development of which would significantly expand the economically viable reserves of geothermal energy.

The temperature of thermal groundwater rises from the surface into the depths of the earth. To extract geothermal energy, convection systems are used that carry deep heat to the earth's surface. There are natural and artificial convection systems that carry various heat carriers to the earth's surface. The costs for bringing geothermal coolant to the surface of the earth are an essential component of the total costs of obtaining heat and electricity. To efficiently use geothermal energy, it is important to explore such areas of our planet where geothermal resources are located at a minimum distance from the surface, that is, areas with an abnormally high geothermal gradient.

The use of geothermal energy also has negative environmental consequences. The construction of geothermal stations violates the "work" of geysers. A large amount of cooling water is used to condense steam at geothermal stations, therefore geothermal stations are sources of thermal pollution. With the same power from a TPP or nuclear power plant, a geothermal power plant consumes significantly more water for cooling, because its efficiency is lower. The discharge of highly mineralized geothermal water into surface water bodies can lead to disruption of their ecosystems. Geothermal water in large quantities contains hydrogen sulphide and radon, which causes radioactive contamination of the environment during discharge.

It is hoped that geothermal energy will continue to develop at an ever-increasing rate, and our country will benefit from this, expressed in saving non-renewable resources (especially oil, which we so actively buy), and in improving the environmental situation. The further development of this type of energy also depends on the volume of investment.

Stanislav Shykhov
V.S. Khilov, research supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Characteristic Features of Reactive Nonlinear Elements

Wide prospects for constructing various functional devices are opened by nonlinear reactive elements using. Such elements allow to obtain new properties that are unattainable in linear electric circuits. There are three types of elements with the properties of nonlinear reactive elements: ferromagnetic, ferroelectric and semiconductor.

Nonlinear capacitances. There are two types of nonlinear capacitances: varicond and varicap (varactor) [1]. In the varicond, ferroelectric with variable dielectric permeability is used as dielectric. The relation between the electric displacement density, $\boldsymbol{D}$, and the corresponding electric field intensity, $\boldsymbol{E}$ is characterized by the fact that the relative dielectric permeability ε of ferroelectric materials is not a constant value, but is a function of the electric field intensity $\boldsymbol{E}$. The varicap is a planar diode.

Nonlinear inductance. The relation between the magnetic induction (flux density) **B** and the corresponding field intensity, $\boldsymbol{H}$ is characterized by the fact that the relative permeability μ of magnetic materials is not a constant value, but is a function of the magnetic field intensity. In essence, all magnetic materials exhibit a phenomenon called saturation, whereby the flux density increases proportionally to the magnetic field intensity, but only to a certain limiting value of the latter. It may be noted that since the *B*-*H* (weber-ampere characteristic) is a nonlinear curve, the value of μ (which determines the slope of the magnetization curve) depends on the intensity of the magnetic field.

The fundamental property of ideal reactive elements makes it possible to develop a new class of energy converters without loss, which is in principle not achievable in linear circuits. Of greatest interest is the use of thin-film metallic magnetic materials by microelectronic memory devices (RAM), where thin magnetic films are used as a memory element. These films allow the creation of reliable high-speed memory with low power management. Memory devices on cylindrical magnetic domains are very promising. The recording density of such devices reaches 105 bits / cm2 at the highest speed of information processing. The advantage of these devices is also that magnetic domains can make up a system of identical elements that realize the functions of logic, memory and commutation without disrupting the homogeneity of the structure of the information carrier material.

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Vladislav Sidanchenko
A.Y. Gusev, research supervisor
V. V. Hubkina, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Noise in the Channels of Receiving Path of Radar Stations

In radar systems angular coordinates are measured by using partial receiving channels in the angular plane. The accuracy of the measurement of the angular coordinates depends on the identity of the amplitude-phase characteristics of the partial receiving channels. In its turn, characteristic identity is determined not only by the spreads of the gain of receiving channels and phase errors, but by antenna characteristics as well. There are difficulties in ensuring high accuracy of identity and stability of the amplitude-phase characteristics of the receiving channels. In order to provide the identity and stability of the amplitude-phase characteristics of the partial receiving channels, correction of the interchannel mismatch is introduced. Due to the fact that the change in the parameters of the partial receiving channels is slow, the correction of the interchannel mismatch occurs during the "silence", that is, in the absence of radiation.

Intrinsic noise of the receiving path of the radar station has a great influence on the spread of the characteristics in the receiving channels. The stabilization of noise power at the output of the analog part of the receiving path is most often performed with the help of noise automatic gain control. Currently, while choosing the schemes for the implementation, preference is given to digital options.

Most universal devices have insufficient speed and do not always achieve the specified real-time computing speed thus requiring the construction of specialized signal processing systems by applying programmable logic integrated circuits.

The analysis of the experimental results of the noise power stabilization efficiency obtained in the process of studying the operation of various systems demonstrated that the main difference between the considered systems lies in the method and accuracy to estimate the value of the envelope power of the noise.

Communication systems are considered to be the main part of highly developing and changing telecommunications industry where the application and study of the principles of adaptive filter operation has proved to be very fruitful.

To support this idea the following reasons can be listed: firstly, the rapid progress of semiconductor technology, and especially the progress in the field of large-scale integrated circuits and ultra-large integrated circuits made it possible to implement adaptive filters at commercially acceptable costs; secondly, the rapid growth of data transmission systems created the need for adaptive filtering to overcome the transmission distortions inherent in existing telephone networks; thirdly, the desire to ensure the improvement of voice transmission systems for those cases when reflected signals cause a significant distortion of sound transmission or instability.

Alina Simonova
Y.P. Rybalchenko, research supervisor
V.V. Hubkina, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Designing the Multiservice Access Network of a District in the City of Dnipro on the Basis PLC Technology

With the global computerization of common people, facilities, companies and special services a necessity of computer networks organization has appeared. One of the solutions to this problem is PLC technology. PLC (Power Line Communication) technology allows using not only power supply networks for communication, but broadband services as well. The main idea of PLC is reducing production and implementation costs.

Broadband PLCs in low-voltage networks are a cost-effective solution for “last mile” of communication networks, so-called PCL access networks. Currently, there are lots of examples of developing and applying PLC technology in the access area. The achievements of PLC-technologies are due to emerging a significant element base including signal processors to assist implementing complex methods of signal modulation. It also allowed ultimately increasing the reliability of information transmission.

PLC technology is a leading technology aimed at the use of the cable infrastructure of power grids to organize high-speed data and voice transmission. Depending on the speed of transmission it is divided into the broadband (BPL), with the speed of more than 1 Mbps, and the narrowband (NPL). PLC is a relatively new telecommunication technology that allows the use of existing power lines to transmit information: trunk, regional, district and internal networks; domestic and industrial networks (including street lines); contact network (electricity supply locomotives, trams, trolleybuses, subway); a network of technological objects (electrical supply of production facilities). The main idea of PLC is applying electrical networks and telecommunications to reduce costs for constructing new communication networks. A network with high, average or low voltage could be potentially implemented to overcome bigger distances thus avoiding the use of an additional network.

The Powerline connection is used in buildings, offices and in this case, the current electrical structure is used to transfer data. There are two ways to expand access networks: creating new networks (implementation of wireless local systems, use of existing and new network access) and applying existing infrastructure (3DSL, PLC methods). Creating new access systems leads to higher costs and is time-consuming. Because of this, the use of existing infrastructure is a more favorable solution.

In the case of a PLC access system for connecting end users or subscribers to the network, a low-voltage network is used. The PLC access networks are connected to the trunk networks via a transformer station, or through any other station in the network. Regardless of the PLC network topology, the connection between users of

the PLC network and the network (WAN) is via the base station. External telecommunication equipment is located on the locating transformer substation and connected to the telephone or IP-trunk and to the electrical network. This equipment is a connection between the public networks and the PLC network. It forms a high-performance connection to the PLC-modem, which is installed in the premises of users. Subscriber PLC Devices are specialized modems with separate filters, which allow cutting off power impulses of high-frequency signal. PLCs modems come with standard interfaces (such as USB RS-232, RJ-45 and Ethernet) for connecting fax terminals, computers, telephones etc.

An Ethernet cord is connected to the router and the other one is to the first adapter. Then, it is plugged into the nearest socket. Further, the Ethernet cable is connected to the HDTV and the second adapter and is inserted into the socket. Adapters automatically detect each other and connect (without drivers and without long configuration process). This allows transferring data packets from a router to TV via electrical wiring in the walls.

The latest PLC equipment provides a transfer speed up to 200 Mbit/s at 84 frequencies in the range of 4 to 21 MHz in ramified networks. Such speed is common for master devices installed at the building entrance or on the transformer substations. With all-in-one modems they are connected to computers through the standard 100BaseTX interfaces. Usually they have an analog phone for connecting the phone. One master device is able to provide access to the Internet via PLC network for 500 users. To do this, it is necessary to install adapter devices in flats that contain PLC modems.

It should be concluded that due to this technology, most users could get reliable access to the Internet service without additional cable routing.

Ilanit Stashevska
V.E. Olishevska, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Modern ways of producing electricity from waves

As everyone knows, even nowadays humanity is experiencing the significant shortage of fossil fuels. That is why people are opting more and more for cars that are using electricity as fuel. So, the more electrocars we have the more electricity they consume. Therefore, technology is focused on finding the way to produce such amount of electricity that will be enough to satisfy the high demand.

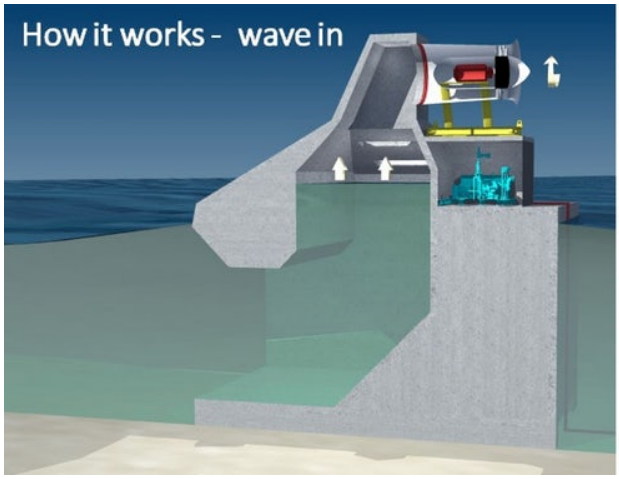
First of all, scientists concentrate their attention on developing solar panels. If we continue moving in this direction, the sun energy will be cheap enough to completely replace fossil fuel energy. However, people get energy from other natural resources, such as wind, water and, in addition to this, waves.

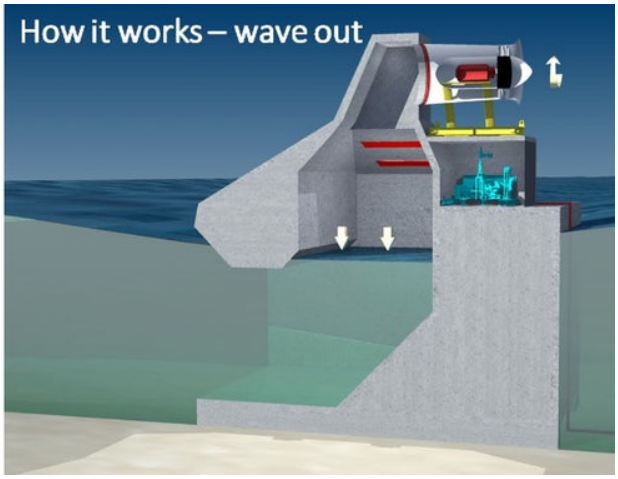
There are several absolutely different ways to produce electricity from waves. First of them has been invented by the Danish company Wavestar. Its development is a sea floating machine on buoys and beams, which is set in motion by the kinetic energy of waves, which is then converted into "clean" energy.

The mechanism turns the kinetic energy of the waves into the desired electricity, with the help of floats that move up and down, in time with the movement of the waves. The floats are fixed by movable balancers, placed on a platform, the supports of which are fixed on the bottom. The movement of floats is transferred through hydraulic pistons to a rotating of generator, which produces electricity.

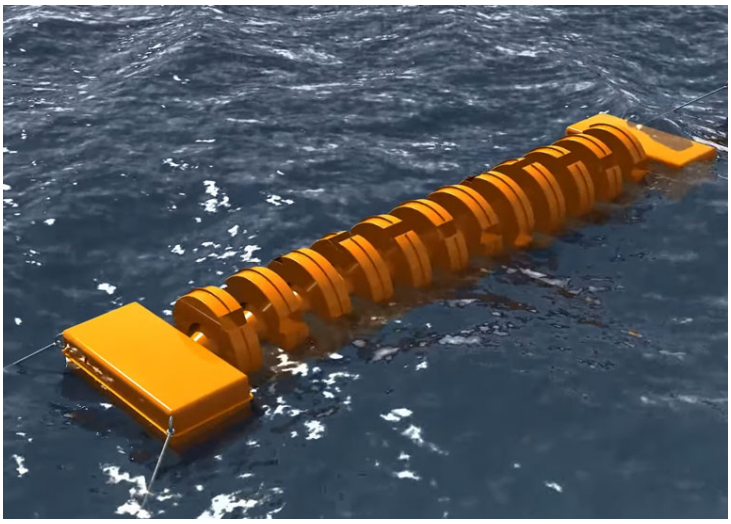
The second one has been developed by the Australian company Wave Swell Energy. An operating principle of the mechanism bases on an oscillating water column. Its work involves two cycles. At the first cycle, increasing of the water level leads to an increase of the pressure inside the underwater chamber, which is partially stabilized by special valves. When the water retreats, the valves close, and in the

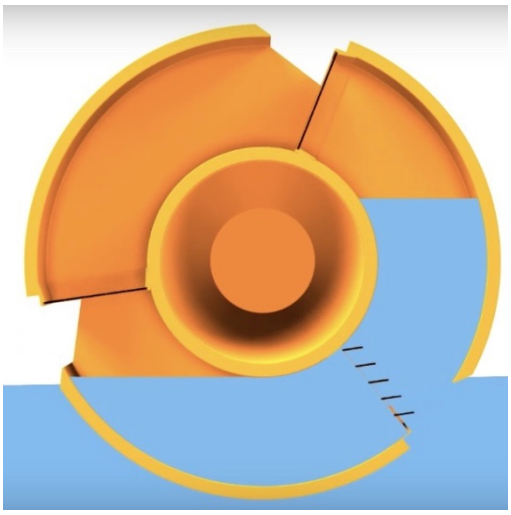
chamber, due to the lowering of the water level, the pressure drops. The air flow drives a unidirectional turbine, which is connected with an electric generator.





And the third one was created in 2016 by 18-year-old Michael Litovchenko from Dnipro. He developed special installations with two chambers, similar to buoys. When the wave rises, Archimedes force acts in one chamber, in the other - the force of gravity, which together rotate the installation, thereby creating electricity, as well as drinking water. If we put the installations along the shore, they will immediately perform several functions: buoyant barriers, breakwaters and a modular power station.





As a result, we get inexhaustible energy without emission of harmful greenhouse gases, which meets current demand for clean and green energy.

Denis Subach
G.M. Korotenko, research supervisor
V.V. Tykhonenko, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

The most ambitious project by Elon Musk

In one of his interviews a well-known businessman Elon Musk expressed his opinion about the necessity of Mars colonization. In his opinion, this should not be done simply because of a strong desire or for carrying out scientific research that can help on Earth. Therefore, in September 2016 he presented the project "Interplanetary transport system". This is a large-scale program aimed at creating on Mars a city with a million of population.

He considers transporting people and equipment to Mars by means of a special-purpose space vehicle. The first stage of the Musk`s interplanetary spaceship will be 77 meters tall and a width of 12 meters. If you add a ship, we get 122 meters in height. The first part of rocket will receive 42 Raptor engines. It is fuelled by liquid methane since it is cheaper, and it can be produced directly on Mars; there will also make a filling depot in order to land a person in the future on the moons of Jupiter and Saturn - Europe and Enceladus.

Intel Planetary Spaceship itself is such a giant "long loaf" which length is 49 meters and a width of 17 meters. Such dimensions are needed to place up hundreds of colonists, plus 450 tons of various cargoes, to deliver a whole village to Mars. The electric power of the ship will be provided by two wings of solar panels. Their total capacity will reach 200 kilowatts.

There is another Mars One project: he selected 24 volunteers who are ready to receive a one-way ticket to Mars. It remains only to manage with the problems that await the first colonists. The martian day lasts 40 minutes longer than on Earth, the difference is quite small, but eventually it will accumulate. Also, for life on Mars you need a special calendar - the Daarias calendar. However, there are more serious problems - the amount of cargo that we can deliver to Mars. A 3D printer which will be able to print houses will be delivered to Mars. Moreover, the European Space Agency plans to build a base on the Moon by using the lunar regolith as a material. Nevertheless, there is also a cheaper way to escape from solar radiation – it is the Martian caves.

It is possible to drop several large asteroids to the surface of Mars, which rotate next to its orbit. We can place huge mirrors in the orbit to reflect the sunlight on the planet surface, or we can build factories on Mars that will produce greenhouse gases. However, Elon Musk believes that it is necessary to bombard the poles of Mars with hydrogen bombs. That will throw into the atmosphere a huge amount of carbon dioxide and water, which will create a greenhouse effect. Today terraforming has only theoretical interest, but in the near future its probability is very high. Venus and even the Moon are considered as the nearest candidates for terraforming.

Evgeniy Suprun
V.S. Khilov, research supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Characteristic Features of Ohmic Nonlinear Elements

The development of modern microelectronics is characterized by the development of a large number of types of integrated microcircuits, primarily the creation of large and super-large integrated circuits and microprocessors, as well as systems on a single chip. In this case, nonlinear resistors are widely used, whose varying properties depend on the value of the applied voltage or the flowing current.

A graphical representation of the nonlinear element characteristics is the most visible [1]. Depending on the type of the current-voltage characteristics there are distinguished nonlinear elements symmetric with respect to the origin, and the asymmetric characteristics. The operating modes of nonlinear elements with symmetrical characteristics are not changed if the signs of current and voltage are changed simultaneously. The operating modes of the nonlinear elements with asymmetric characteristic are essentially dependent on the signs of the current and voltage at the terminals.

For example an incandescent lamp with a metal thread has a shape of nonlinear characteristic. Change of the slop angle of U-I curve is explained by the fact that as the current increases, the filament is being heated more, and internal ohmic resistance of the metallic filament also increases. A varistor is a semiconductor device having the nonlinear current-voltage characteristic also. With increasing applied voltage the change rate of the varistor conductivity is decreasing regardless of the applied voltage sign. Symmetrical shape of the varistor characteristics is used in both DC and AC circuits.

Forward-bias branch of a semiconductor diode current-voltage characteristic corresponds to the forward displacement of the p-n junction. With the voltage increase the direct current rapidly increases. This current is conditioned by the motion of the majority carriers through the lowered potential barrier. However, once the main charge carriers have moved to the opposite area, they become minority carriers. Such process of the introduction of majority carriers from the opposed areas without changing the sign of the voltage and current by lowering the height of the potential barrier is called injection.

Thus, non-linear elements impart specific properties to electric circuits that are unachievable in linear circuits, which allows the development of new functional devices: rectifiers, inverters, stabilizers, voltage, current, power amplifiers, etc.

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Ann Suzimova
E. A. Yavorskaya ,research supervisor
L. A. Zaika, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

The Level of Efficiency of People Searching under the Rubble

The coal mine is a unique complex production system with particularly hazardous conditions such as explosion hazard, fire hazard, danger of explosion, danger of water and gas breakdowns and breakthroughs, it is also an enterprise where unforeseen and sudden changes in geological conditions or natural forces, non-observance of these Rules or incorrect actions of even one worker can lead to disastrous consequences for a large number of people.

The requirements of the Rules are mandatory for all workers involved in the design, construction and operation of mines, buildings, structures, machinery, equipment, instruments and materials, as well as for persons whose work or training is related to visits to the mines.

These Rules establish the procedure for the safe conduct of mining operations and the use of mining, transport and electrical equipment, ventilation and emergency protection of mine workings, ensuring a dust and gas regime, safety and labor protection.

Serious hard work should be provided with confidence in the correct execution of multiple aspects that are driven by a continuous mine mechanism of labor. Therefore, each mine has to be developed and approved by the director or owner of the management system of labor protection. A labor protection service and an approved staff of engineering and technical workers should be established for their operation.

The occupational safety and health services are subordinated to the director of the mine and are equated with the main production and technical services. On their account there are, a lot of responsible complex functions that are beyond the power of other employees. It is difficult even to imagine the work of the mine without safety rules. The main thing is to understand the whole risk of system crash without following such rules. The danger of working in mines is associated with the threat of landslides, which, as a rule, are caused by a gas explosion. Nowadays, there is no way to prevent explosions and collapses, since the sudden explosion in the mines is caused by the release of methane and the presence of explosive coal dust, but there is a huge opportunity to reduce the number of accidents while observing safety rules. Recently, there have been more cases of explosions in mines that have repeatedly led to human casualties. Such an outcome was due to the often low search operability or the lack of effective means of searching for victims. Therefore, it is necessary to disclose important aspects of increasing the effectiveness of people searching under the rubble in order to avoid subsequent sacrificial events.

Initially, one of the main tasks of ensuring safety at work in mines is the timely prompt notification of personnel about the occurrence of an accident by means of

emergency notification, namely reports by the mining dispatcher in any form of transmission: code, text, speech, to underground workings individually to each miner regardless of his location in time and after an accident. The warning system must remain operational throughout the entire functioning of the mine.

In case of underground accidents accompanied by rock falls, a situation often arises when the mine personnel is isolated in the excavation sites under the debris or often the personnel falls directly into the rock debris. In these conditions, the effectiveness of work to eliminate the consequences of accidents can be significantly increased if the mine-rescue units have information and search facilities for contacting the victims under the debris and for locating people who have fallen directly into the blockage area. Means of localization of victims in the obstructions would facilitate the accelerated rescue of many of them, as well as reduce from of the economic costs associated with the elimination of the consequences of underground accidents.

One of the main tasks solved in the development of any radio engineering system is the choice of the radiating device. Since the work of existing radio-technical means of searching for people under the rubble is considerably complicated by the strong attenuation of radio waves under the ground, therefore the range of detection of objects behind the block is essentially limited.

There are several basic technical requirements for systems that search for people in mines underground.

First, as a result of the explosion, the mine equipment in the workings may be damaged, including security devices using a wired communication channel. For this reason, it is advisable to use mobile wireless devices to search for people under the rubble that have an undamaged communication channel and can fully ensure the efficiency of the search.

Secondly, it should be possible, with the help of a minimum number of measurements, to determine the location of miners under the rubble accurately. Therefore, there are locating receivers that perform searches by multi-position measurements by two types of non-directional magnetic antenna - roughly and directional pin - exactly, by this method they help speed up the search process, depending on the complexity of the situation with less lost time.

The object is localized by receiving and processing the signal of the active radio beacon by search devices at three points not lying on one straight line, the so-called trilateration method. The distance is determined by the attenuation of the low-frequency signal. Next, the coordinates of the location of the victims are determined with subsequent refinement of the measurements by the iterative algorithm.

The system should provide the required search speed, potential range and accuracy of the object detection and be able to locate and identify each person from the working personnel located in a potentially dangerous area or under a blockage.

Andrii Tipikin
K.S. Zabolotniy, research supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Concept Development of Segment Erector Equipped with a Boom-Mounted Cutting Head

The aim of the research is to develop the concept intending to increase productivity of the tunneling process. Productivity increase is achieved generally through the adding of a boom-mounted cutting head to the existing construction of the segment erector.

The study of improving the efficiency of tunneling equipment is being performed under the agreement between the National Mining University and PJSC "Dniprovazhmash".

The concept is related to mining, particularly to the tunneling operation. Segment erector is the machine for assembling segmental tunnels in mines, submerged and station tunnels of the subway.

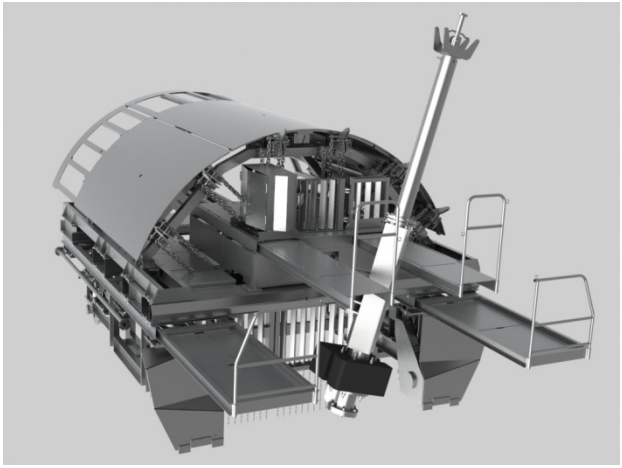


Fig.1 — Segment erector UTK-2 by Dniprovazhmash

Existing construction of the tunnel stacker is equipped with:

- manipulator for mounting the concrete segments or tubings;
- support feature to temporary hold the not-fixed segments;
- rotation drive of the manipulator;
- drive for each wheel allows to the machine to move through the tunnel;
- retractable shelves for staff to access each of the segment being mounted.

Elongation of the tunnel is performed in fixed technological cycle. Completing of the one cycle means adding to the existing tunnel one more segmental tunnel ring.

One technological cycle is performed by sequence of the following sub-operations (in general case):

- destruction of a rock mass

- cleaning up the gob
- moving out equipment for rock destruction
- moving equipment for the segment mounting closer to the gob
- mounting segments into the new segmental ring of tunnel lining
  - rock is broken down by length of one segmental ring (typically 1 m)
  - manipulator inserts ring elements (segments) one by one from bottom to sides and finally top
- moving out equipment for the segment mounting
- moving equipment for rock destruction closer to the gob

The disadvantage of the known technical solution is low productivity caused by the need to use a separate equipment for the destruction of a rock mass. It leads to significant increase of the duration of one cycle of tunnel elongation with a new ring.

The purpose of the concept model is to improve the design of the tunnel stacker to improve productivity by reducing the intervals between the technological operations.

The task is solved by completing the design of the segment erector with a boom-mounted cutting head. This allows to perform rock-destruction operation right with the erector. In this case, separate equipment for rock-destruction is not needed, consequently the time for moving machines along the tunnel is notably reduced.

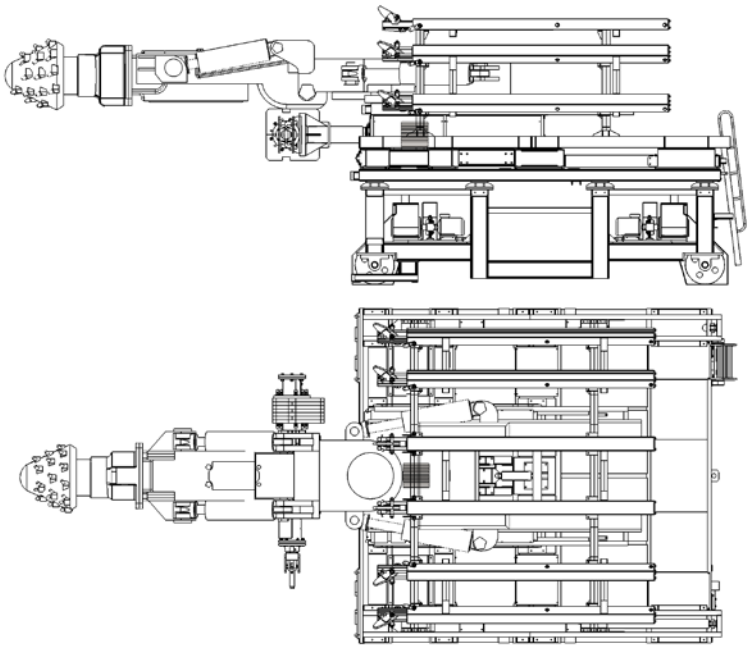


Fig.2 — Concept of a segment erector equipped with a cutting head

The technical results are: the reduction of intervals between the technological operations, which is achieved by the exclusion of one complete technological cycle of the tunneling, and the elimination of extra transfer processes, including the passage under the stacker to the face, and back to the space behind the erector in the completed part of the tunnel.

Olexandra Tryfan
O.O. Yavorska, research supervisor
V.V. Tykhonenko, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Role of Psychophysiological Examination and Features of Its Undergoing while Performing Hazardous Operations

Taking into account the nowadays increased intensity of professional activities, there is a problem of toughening the requirements for psychophysiological qualities of people. Industrial companies in the EU countries and well as the USA solve the problem of human factor with the help of professional psychological and physiological selection, e.g. there are 1200 state centers of vocational counseling and selection in the USA affiliated to the Ministry of Labour. World practices show that even if employees have corresponding education and qualification, they may be not able to work under tough conditions due to the specific features of their characters. So-called “critical professions” require quick reaction, reliability, good self-organization etc. Psychophysiological examination (PPE) as the constituent of professional selection is one of the key measures to preserve working capacity, health as well as to reduce accidence level at productions. In terms of Ukrainian legislation, there are normative documents regulating PPE: the Law of Ukraine “On Labour Protection” and the Order of the Ministry of Public Health of Ukraine “On Approval of the List of Jobs with the Need of Professional Selection”. The problem is both of economic and social character as inappropriate work of certain employees may result not only in economic losses but even in technogenic disasters.

It should be noted that current normative and legislative acts stipulate the necessity of professional psychophysiological selection in terms of hazardous operations; however, the documents do not determine organizational system and the procedure of the examination. PPE is used to define the level of attention, memory, stress-resistance, spatial orientation, resistance to monotonous operations, reaction etc. PPE is carried out by health protection institutions of various forms of ownership meeting the specified qualification requirements: certain licenses, accreditation certificates, and corresponding material and technical facilities. Any applicant should submit specific documents, i.e. personal data processing consent, appointment card from his/her place of work, passport, military card, and medical treatment record.

There are four possible forms according to the PPE results: Recommended without precautions (PPE 1 group, the workers are fully recommended to work under hazardous conditions); Recommended (PPE 2 group, the workers are recommended to work under hazardous conditions); Recommended with certain precautions (PPE 3 group, the workers meet the professional requirements minimally being recommended to work under hazardous conditions with certain limitations); and Not recommended (PPE 4 group, the workers are not recommended to work under hazardous conditions as they do not have proper professional psychophysiological properties at all).

Yulia Tutunik
N.Yu. Shvager, research supervisor
N.O. Holiver, language adviser
Kryvyi Rih National University, Kryvyi Rih

Risk as Hazard Assessment

The main issue of the theory and practice of health and safety is the issue of raising safety. Therefore, at the stage of development of any production, it is necessary, as far as possible, to include elements that exclude hazard. If the identified hazard cannot be completely eliminated, it is necessary to reduce the likelihood of its occurrence to the acceptable level by choosing the appropriate solution. There are several ways to achieve this goal. This can be a complete or partial refusal of work, operations and systems that are of high degree of risk; replacement of dangerous operations by others - less dangerous; improvement of systems and objects, or use of technical or organizational measures set forth above.

To provide a quantitative assessment of health and safety it is necessary to take measures to increase occupational safety. Such a quantitative hazard assessment is a risk. According to DSTU 2293-99:

> Risk is the probability of causing harm based on its severity.

When assessing the risk, as the probability of occurrence of an adverse event, the risk (R) is determined by the ratio of the number of events with undesirable consequences (n) to their maximum number (N) for a specific time period:

$$R = n/N$$

The given formula allows calculating the sizes of general and group risk. In the overall risk assessment, N determines the maximum number of all events, and in the case of group risk assessment, the maximum number of events in a particular group, selected from the total by a certain sign. In particular, the group may include people belonging to the same profession, age, gender; a group may also be of the same type; one class of business entities, etc. The risk in all these cases is of dimensionless magnitude.

A typical example of the definition of general and group risk can be the calculation of the numerical value of occupational injuries. Occupational hazard is the probability of harm to the employee's health during the performance of his employment duties.

For example, the total number of employees in a particular industry is 30536 people, the number of victims of accidents for the reporting period (year) was 47, and the number of deaths is 13. We determine:

R = 47/30536 = 1,510-3;
R = 13/30536 = 42,610-5.

In contrast to the assessment of production hazard in assessing occupational hazard, the severity of the consequences (health and disability rates of employees), i.e., damage, is taken into account. According to hygienic classification of labor, occupational hazard is the magnitude of the probability of violation (damage) of health, taking into account the severity of the consequences as a result of unfavorable influence of factors of the industrial environment and labor process.

When assessing a risk as a potential hazard that can be caused by an adverse event, the risk is defined as the product of the probability (n / N) of the adverse event (D) that it may bring:

$$R = (n/N)D$$

To determine the risk in world practice, the principle of ALARA (As Low as Reasonably Achievable) is accepted: "Any risk should be reduced to the extent practicable or to a level that is as low as reasonably achievable."

The most universal quantitative measure for determining harm is the value, that is, the definition of damage in monetary terms, although sometimes, for example, when it comes to human life or health, it is unacceptable.

An example of the use of occupational safety risks, as the probability of occurrence of an adverse event is the rate of injury, and as a potential damage - the coefficient of production losses.

From the standpoint of occupational safety, the risk is determined for the factors of the production environment (technique, technology, labor organization and the state of industrial safety), affecting the magnitude of occupational injuries, professional and production-related morbidity, and is used to develop systems of technical and organizational measures aimed at reducing injuries and morbidity in the workplace.

Victoria Valevska
I. N. Lutsenko, research supervisor
L.A. Zaika, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Increasing the Energy Efficiency of Solar Panels

Most solar cells used in homes and industry are made using thick layers of material to absorb sunlight, but have been limited in the past by relatively high costs. Many new, lower cost designs are limited as their layer of light-absorbing material is too thin to extract enough energy. The efficiency of all solar panel designs could be improved by up to 22 per cent by covering their surface with aluminum studs that bend and trap light inside the absorbing layer. At the microscopic level, the studs make the solar panels look similar to the interlocking LEGO building bricks played with by children across the world. It is required to attach rows of aluminum cylinders just 100 nanometres across to the top of the solar panel, where they interact with passing light, causing individual light rays to change course. More energy is extracted from the light as the rays become effectively trapped inside the solar panel and travel for longer distances through its absorbing layer.

In the past scientists have tried to achieve the light bending effect using silver and gold studs because those materials are known to strongly interact with light, however these precious metals actually reduce the efficiency as they absorb some of the light before it enters the solar panel. Let's compare the results of the aluminum array LEGO with identical arrays of gold and silver. Via detailed comparison of photocurrent enhancements given by Au, Ag and Al nanostructures we reveal that parasitic losses can be mitigated through a careful choice of scattering medium. Absorption at the plasmon resonance in Au and Ag structures occurs in the visible spectrum, impairing device performance. In contrast, exploiting Al nanoparticle arrays results in a blue shift of the resonance, enabling the first demonstration of truly broadband plasmon enhanced photocurrent and a 22% integrated efficiency enhancement.

The interplay between scattering and absorption in nanoplasmonic systems has recently been the subject of intense research efforts. Indeed it has been shown that carefully designed metallic nanostructures can be tuned to provide a desired optical response. This delicate balance of plasmonic absorption interactions versus far-field scattering properties can have implications in a number of fields, of which solar energy is a prime example. Both near-field confinement as well as far-field scattering and light trapping effects have the potential to deliver absorption enhancements in solar cells, however parasitic absorption in metal nanoparticles remains a key problem yet to be overcome. This is an issue of particular importance since large-scale solar cell deployment requires efficient use of materials and there is therefore a need to move towards thin-film solar cells without compromising energy conversion efficiency.

Attempts at tuning the balance between absorption and scattering have to date focused on altering the shape and dimensions of noble metal nanostructures.

However, in the field of solar energy where mass production is an economical necessity it is prudent to employ simple, easily producible structural parameters.

Therefore, let us turn our attention to the use of alternative metals to compensate for the trade-off between scattering and absorption. In particular, it is necessary to compare nanoparticles obtained from Au, Ag and Al. Drastic differences in both scattering and absorption can be achieved for the different metals, even for simple nanoparticle geometries. Al in particular provides significant scattering with minimal absorption over much of the visible spectrum. We note also that Ag particles of radius >70 nm actually exhibit the lowest absorption cross-section efficiency, however these dimensions do not coincide with those required for maximum scattering. In fact only in the case of Al do the conditions for maximum scattering also result in low absorption, making it an attractive candidate for solar energy applications. It is also noted that aluminum has recently been of interest as a plasmon material, since it makes it possible to shift plasmon resonances from visible frequencies and to ultraviolet radiation.

When comparing the photocurrent response of GaAs photodiodes with Au, Ag and Al nanocylinder arrays, it became obvious that losses sustained by arrays of Au and Ag at short wavelengths dominate, making these arrays impractical. In the case of Al nanoparticles, on the other hand, parasitic loss was minimized and dispersed dominant, leading to increased broadband coupling. Using such arrays of Al nanoparticles, it is possible to achieve an increase of 22% in the spectrally integrated EQE. This type of broadband enhancement opens up the possibility of moving to the production of solar cells with thin film absorbers without compromising power conversion efficiency, which reduces the consumption of materials. As for the key factor that enables aluminum to vault over gold and silver, the precious metals tend to absorb light into themselves. Aluminum, in contrast, simply bends and scatters light, passing it along to the solar cell. As an added advantage, its light weight and flexibility make it compatible with the new generation of flexible solar cells.

That’s a significant breakthrough, because until now gold and silver have been the focus of attention in the solar cell efficiency field due to their vigorous interaction with light. This is the first example which was considered that involves integrating aluminum into a solar cell, but there is a growing number of examples of aluminum used in solar modules.

A recent example is a new hybrid solar thermal power plant that uses aluminum framing to support thousands of curved mirrors, a new nano-engineered aluminum alloy that could make solar modules lighter and more flexible, and a concentrating solar system using aluminum instead of glass-based panels. An additional advantage to this solution is that aluminum is cheaper and far more abundant than silver and gold. The future success of this technology opens up the possibility of making flexible solar panels that could be applied to any flat or curved surface, which could be used to power everything from domestic appliances to portable electronics like laptops.

Arina Vershinina
N.M.Triputen, research supervisor
V.V.Tikhonenko, language assistant
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Identifying the technological process of desludging

Nowadays, increase in production efficiency of raw materials at mining and processing integrated works (MPIW) for metallurgical conversion is one of the problems which ore mining industry faces. In terms of processing factories of MPIW, one of technological processes is the process of desludging of hydroclones draining before magnetic processing and desludging of a concentrate prior its filtering. Disposal of slimes as well as condensation of finely crushed magnetite products in most cases is carried out in magnetic desludgers МГС-5.

The processes within the desludger are of non-stationary character and depend on many parameters which are still difficult to control properly. Besides, nonlinear dependences between input and output values can be observed. The specified features complicate the synthesis of automatic control systems. In many respects the correct selection of the principle of control, development of the structural scheme and calculation of the parameters for automatic control system is defined by the results of the process identification.

The desludger is developed as the device with hydrostatic unloading. To obtain small quantity of a concentrate (losses) during the flowing run unit and to have high-quality extraction of nonmetallic particles from the pulp, it is necessary to support the specified height of a magnetite flocculated layer at certain level. Therefore, the desludging process is controlled by the change in the degree of opening of the unloading valve *H* depending on the level of the condensed product. Level of the deposit (magnetite) on the bottom is determined by the indirect parameter – hydrostatic pressure *P* controlled by a sensor.

Dynamic model of the desludging process within the channel "degree of opening of the unloading valve *H* – hydrostatic pressure on the desludger bottom P" is implemented according to passive experiments which were registered with T=30s discretization . Data were processed by a least-square method. The obtained model is tested for adequacy. It is established that, in terms of this channel, the studied process demonstrates the integrating link with z – transfer function, being represented as follows:

$$W(z) = \frac{T}{K(P)(z-1)}$$

where $z = e^{pT}$ (p – a complex variable); K(P) -is the coefficient depending on a hydrostatic pressure value. Besides, *K(P) = 52.38 – 37.98P.*

Thus, the desludging process within the channel “degree of opening of the unloading valve *H* – hydrostatic pressure on the desludger bottom *P*” represents the nonlinear integrating link. Such object is possible to operate using methods of nonlinear control.

Egor Yudin
A.A. Martynenko, scientific supervisor
N.M. Nechai, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

3D-printer for humanity

Today there are many different technologies which aim to improve human life. One of those technologies called 3D-printing lays in creating 3D-objects based on a virtual 3D-model. To create something, first you need to design a 3D-model of an object in a program for 3D-modelling. Then you import your 3D-model to special software and start printing. After that your object will be created layer by layer.

There is no universally accepted classification of 3D-printers, but they can be divided by technology used, by the spheres of application: industrial, laboratory or for home using; by the number of printheads, by the color: monochrome or multicolor; by the number of consumables.

The technologies used for 3D printing are numerous, among them are: Stereo Lithography Apparatus, Selective Laser Sintering, Ink Jet Modelling, Fused Deposition Modeling, Binding powder by adhesives, Laminated Object Manufacturing, Solid Ground Curing, Color 3D-printing. All these technologies exist, but not each is used because of the high price of printers and consumables. Some of those technologies have the same principle of action, mostly laser aimed at the photopolymer or combining layers of materials under the high temperature. Regarding materials, ceramic powder, metallic clay, photopolymers, wax, ABS plastic and a lot of others are used in 3D-printing nowadays.

3D-printing is becoming increasingly popular as it can be applied in various fields including construction industries, architecture, manufacturing, garment industry and even medicine. For instance, thanks to 3D-printer there is an opportunity to build unusual houses even in the form of a Möbius strip without any effort. In addition to amazing architectural works it is possible to build ordinary houses in a very short time. It can be assumed that in a few years there will be whole towns with gorgeous houses built with 3D-printing technology.

Thanks to 3D-printing there is a possibility of making protheses that takes much less time than the usual way of making them. Medical 3D-models can be made from a variety of materials, even the organic cells. In that way an artificial beak was made for an eagle that lost his real one because of poachers. Moreover, 3D-ultrasound scan is now available for the pregnant. Recently "Huggies" decided to help a blind mother and printed the image of her son's face with the help of 3D-printer. There was a Braille inscription: "I'm your son". So, she was able to touch a model of her son's face.

It can be concluded that a 3D-printer is a very relevant and needed device, as the scope of its application is incredibly huge. It can be assumed that in the near future 3D-printer will become as integral attribute of a modern life as a fridge, television or a microwave oven.

Section 02. Geotechnical Systems Stability

Bogdan Babenko
A. A. Ignatov, research supervisor
L. A. Zaika, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Other Questions of Directional Drilling Technology

At the present stage of the development of drilling technology with a purpose of correction of the hole direction or artificial direction, single, periodic and continuous deviators are widely used. The most complicated of the design are deviators of continuous action of a gliding type. Nevertheless, these devices have certain disadvantages: the complexity of the design, the instability of the work of the deviation joint and significant intensity of distortion when creating required axial load.

In order to solve the problem of improving the device for directed drilling, the Department of technical prospecting of deposits of the National Mining University developed a design of the whipstock (Fig. 1). Structural features of the operation and functioning of the working bodies provide required spatial orientation of the device, regardless of the axial load and hardness of the rocks. As a result, the quality of the well profile implementation increase.

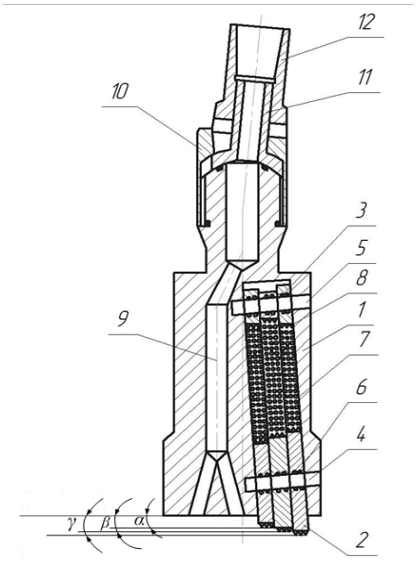


Fig. 1 Common scheme of the directional drilling device

This device works in the following way: when arranged at the bottom and penetrating the formation the chains 7, on the outer surface of which are placed teeth 8 and toothed disks 2 break the rock. Chains 7 and the toothed disks 2, due to the kinematic connection and the chain wheel 3, rotate under the influence of the reaction forces of the well bottom. Due to the difference in the diameter of the toothed disks 2, the required deflection of the device body 1 is reached and it allows to direct well to the desired spatial position. The angle of the well deflection consists of the sum of the angles achieved by each of the disks 2, that is, $\alpha + \beta + \gamma$. The rotation of the device is provided due to the presence of a mobile gear connection between the hinge 11 and the body 1. In order to prevent turning of the hinge 11 inside the crossover sub 12, it is attached tightly. The change of bushing 10 allows reaching a certain limit of the maximum value of the angle of the device inclination.

The intensity of the curve of a borehole is directly determined by the possibility of operative replacement of the working bodies of the device – chains 7 and the toothed disks 2 and the additional limitation of the angle of inclination due to the sleeve 10 in accordance with the necessary geometric ratios, even in field conditions.

The current device is distinguished by the possibility of application not only in production wells, which are known to have a significant diameter, but rather small diameters of geological exploration that most often require inclination. Also, the device has a relatively simple spatial orientation scheme, which only provides its oriented descent, without any other operations. It is achieved by constructive implementation of the blade distorter, to put it more precisely, by a moving toothed coupling between the hinge and the device housing. It allows inclination only vertically (position, in this case, is determined by an oriented descent). Slight difference in the diameter of the toothed discs and moving helical-shaped contact of the chains with the walls of the well provide smooth curvature and rigid centering of the device with the appropriate calibration of the well walls without breaking. When symmetrically replacing the position of the toothed disk, the device can also be used to correct the distorted wellbore. For the theoretical study of the support operation, a differential equation can be used to determine the distribution of the pressure P in the bearing friction zone without taking into account the influence of the inertial forces on the lubricant movement,

$$\frac{\partial}{\partial x}\left(h^3\frac{\partial P_1}{\partial x}\right)+\frac{\partial}{\partial z}\left(h^3\frac{\partial P_1}{\partial z}\right)=0. \quad (1)$$

whereas h is the thickness of the oil layer.

The coordinate system for equation (1) consists of an axis Z normal to the friction surface.

Therefore

$$P_1 = P^{1/\chi+1}, \quad (2)$$

where $\chi = \infty$ in case of using fluids.

The role of the circulation liquid in the operating conditions of the device in most cases is: the removal of borehole cuttings, cleaning and cooling of discs and chains (both in the area of interaction with the rock and the kinematic contact in the tool itself), ensuring a high degree of lubrication in a chain-disk pair and finally creating a rational reduction of friction units wearing.

As shows the research, injection of surface-active additive in the circulation liquid provides a significant reduction of wearing of the support unit of the device.

Estimation of antiwear properties of circulation liquids is possible by comparing the wearing indicators of the bodies which are present in the environment.

The following wear indicators are applied: speed; intensity; wear resistance; relative wear resistance. It is important to mention that along with the listed, other indicators of wear, such as mass wear, are used, which are particular rather than general.

Naphthenic acids are more active in oxidation of metals. The question of corrosion of a drilling tool in hydrocarbon solutions of fatty acids is insufficiently studied. It can be assumed that on metal surfaces of friction, at high temperatures, chemisorption prevails over physical adsorption. Moreover, its greatest intensity is observed in places with a breach in a stoichiometric metal lattice, for example, in places of inclusions.

Iryna Binevska
Y.A. Sherstiuk, research supervisor
V.V. Tykhonenko, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Analysis of the stability of Quaternary-deposit slopes in the central part of Dnipro in terms of groundwater level rising

Nowadays, more than 20 different types of exogenous geologic processes and phenomena have been developing in Ukraine. Landslides take the special place among these dangerous geologic processes causing unbalance of sloping territories. Currently, 22 937 landslides are distinguished in our country with their total area of 2134.92 sq. km; 1751 ones are active landslides with a total area of 92.61 sq. km. The number of landslides has increased by almost 40%; their spread area has increased by 28.8 % compared with the1980s.

Landslides are the most hazardous natural and technogenic processes. They cause significant economic losses and always have negative environmental and social effect.

In Ukraine, landslides are widespread due to the local geological structure and geomorphological conditions; these factors determine a possibility of occurrence, spatial layout, and intensity of this dangerous geological process development.

In the context of Dnipropetrovsk region, landslide activation spreads widely owing to both a high-developed erosional relief and a fact that large part of the considered area is composed of loessial soils that change their properties rapidly with water saturation. Today Dnipropetrovsk region has landslides which are in an active stage of development. In Dnipro more than 500 apartment houses are located at sites where there is a danger of landslides; 40 houses of them are to be resettled. The most dangerous landslide activation is observed on the slopes of following ravines: Krasna, Aptekarska, Zustrichna, Tonelna, and Krasnopovstanska.

Basing upon the aforementioned facts, we have the topical issue of slope state examination and developing the methods to increase slope safety within a built-up area because an incorrect assessment of the stability of landslide territories and following predictions can lead to heavy economic and human losses. While assessing slope conditions the most important problem is a reliability of slopes stability calculation and their effective reinforcement.

The objective of the paper is stability estimation of one of Krasnopovstanska ravine slopes where the construction site of residential buildings is located. The site is in the central part of Dnipro, Soborny district, in the city block confined by Hohol street, Patorzhinsky street and Shevchenko street. Correspondingly, tasks of the paper are to identify a degree of slope stability and to define the required measures to protect it in case of necessity.

In terms of geomorphological characteristic, the area under consideration is confined to 3rd terrace above flood-plain on the right bank of the Dnipro river and

located on the right slope of Krasnopovstanska ravine that has general steepness of 10…12°. The slope had an artificial terracing during construction of residential buildings in the neighborhood of the site.

Geological cross-section of the investigated area consists of sediment soils of Middle Pleistocene. Surface of the whole complex of sediments is covered by fill-up soils; loessial loamy light sandy are bedded below with layer thickness of 17.5…22.2 meters at the construction site to 1.2…11.1 meters in the area of ravine thalweg. The hydrogeological condition of the territory is characterized by the availability of one phreatimetric aquifer with hydrostatic level depths of 15.3…19.2 meters at the construction site and 4.6…8.3 meters at the lower part of the slope.

Nowadays there are many various methods for slope stability estimation: a cylindrical surfaces method (Fellenius method), a method of horizontal forces, a method of strength balance of side slope, a method of block and prisms etc. Furthermore, there are more sophisticated numerical methods (numerical simulation) which allow studying the stress-strain state of a slopes comprehensively. The carry out the study we have applied the method of horizontal forces (Maslow-Berer method) for slope stability estimation; its essence is to determine an active pressure of the soil within a block on the retaining wall with a vertical back face and sliding surface that is inclined at α angle. In this method safety factor will be determined as follows:

$$K_s = \frac{\sum Pi[tg\alpha i - tg(\alpha i - \psi)]}{\sum Pitg\alpha i},$$

Safety factor is a ratio of restraining forces to shearing forces. The sliding surface was identified by means of trial and error method; it was replaced with some approximation by a set of straight lines (slip lines) within the drawing plane.

The considered slope was divided into 11 elementary slices. Geometrical parameters, weight, an angle of the sliding surface as well as shift angle were determined for each slice. The calculation was carried out taking into account a filtration pressure. Moreover, we considered several different conditions for Safety Factor identifying: loading of the available buildings and potential flooding (the groundwater level rise of 2.0…8.0 meters); a total load of the available and designed buildings and potential flooding.

In terms of all possible conditions, the results of the safety factor estimation indicates that K_s exceeds 3.0 that points to the sufficient stability of the slope. In other words, engineering-geological conditions of the studied area allow performing construction of future residential buildings.

As mentioned before, the whole analyzed strata are composed of loessial soils which are subject to destruction from soakage, therefore, it is recommended to take measures concerning surface land run-off removing. In case of groundwater level rise above the critical, a stable state of the construction site can be ensured only after the implementation of dewatering measures.

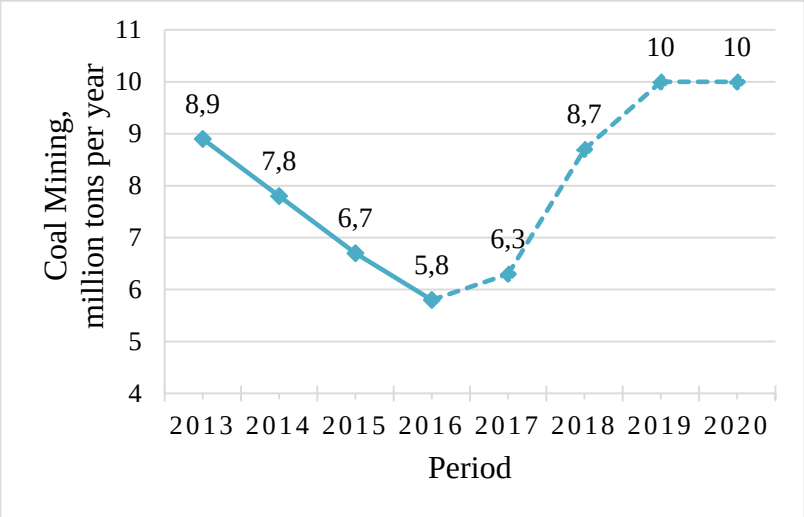
Vladyslava Cherednyk
O.M. Shashenko, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Patterns of Adjacent Rocks Deformation in Lava During Working Out of Flat-Lying Coal Seams

The energy sector in different countries has its own features, but now there is a worldwide tendency to increase the use of renewable and alternative sources. However, at this stage, it is not possible to abandon a wide range of fossil hydrocarbons resources that are used for the needs of energy, chemistry, building construction etc. Consequently, there is a need to satisfy the increasing needs of modern society in the amount of electricity produced. That is why the production of hydrocarbons, including coal, is constantly increasing.

The concept of sustainable development and world trends in energy are a serious challenge for Ukraine because a greater number of enterprises in the industrial sector operate using fossil energy sources. Coal and natural gas account for 60% of Ukraine's energy structure. The “New Energy Strategy of Ukraine Until 2035” projects the increase of the renewable energy part up to 12% of the total primary energy supply by 2020 and up to 25% by 2035.

However, according to the "Concept of Reforming and Development of the Coal Industry Until 2020," the projected coal output is estimated as 8.7 million tons in 2018, and more than 10 million tons annually in 2019 and in 2020 (Fig.1).



The above data and the difficult situation in the national economy lead to the need for coal industry restructuring, preparing state mines for privatization and unprofitable mines for liquidation in line with European trends.

However, this process will take a considerable time, that is why the primary tasks for coal industry of Ukraine are rational use and further development of the fields that are currently being exploited.

The future of underground mining will depend on more efficient use of resources and innovative methods to increase the productivity of coal seam mining. This will increase the volume of extracted raw materials and reduce its cost price.

For the tasks described above the geomechanical models are being developed. They allow forecasting parameters of excavation systems, support and the amount of

repair work. Such model was developed in case of the Krasnolymanska Mine. It imitates the deformation process of adjacent rock during the coal seam excavation.

The thickness of coal seam changes from 1.3 meter till 3 meter, that corresponds to the real geological structure of Krasnolimanska's coal seams. During the numerical modeling an assessment of the effect of changing the thickness of a coal seam was made, in case that all other conditions being equal - geological structure of adjacent rock, depth of excavation, the angle of seam inclination, pressure etc.

The general view of the geomechanical model is shown in Fig. 2, where *m* is coal seam thickness. Calculations were performed in the software package Phase2 of the Canadian company Rockscience.

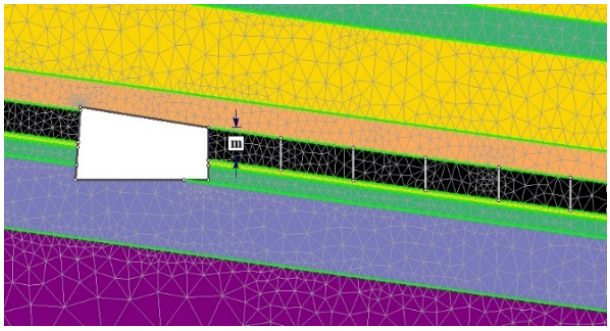


Fig. 2. The general view of the geomechanical model

The model calculation gives an opportunity to find the point where roof and floor contact, and find the distance from lava face to the closing point. The dependence of the distance from lava face to the closing point from the thickness of the coal seam is shown in Fig.3.

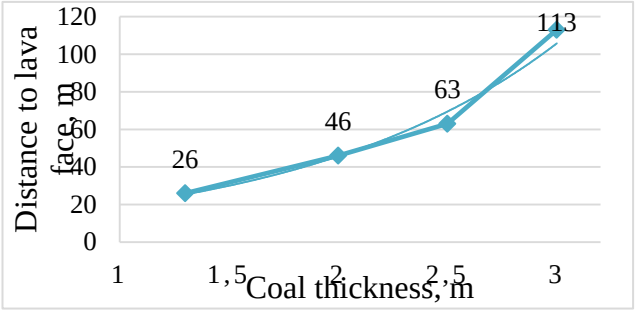


Fig.3. Dependence of distance from lava face to the closing point from the thickness of the coal seam

For the mining and geological conditions of Krasnolymanska Mine the geomechanical model considering the geological structure, physical and mechanical characteristics of rock mass has been developed. The step roof and floor closure for different values of average seam thickness has been determined. Dependence of the distance from lava face to the closing point from the thickness of the coal seam, based on the numerical modeling results, has been received. The given value in the specific mining and geological conditions is constant while lava face is moving and it depends on the seam thickness.

Yevheniia Dementieva
L.O. Tokar, language adviser
A.B. Moskalenko, research supervisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Hydrogeological conditions of Orehovo-Pavlograd zone

The territory is located within the jointing zone of two hydrogeological areas of the first order: Ukrainian basin of fissure water and Donetsk basin of bed-block water. The two regions differ considerably in terms of the conditions of accumulation, discharge, and formation of chemical composition of ground waters.

Ground waters are within Quaternary deposits, within the deposits of Neogene-Paleogene Age, and fissure zones of crystalline Precambrian rocks and their weathering crust.

A water-bearing level being first from the surface is formed within the eolian-deluvial loessial loamy clay. The level is observed within the boundaries of upland and its slopes. Reddish-brown clays from the level bottom; if there are no clays, the bottom is formed by Precambrian crystalline rocks. Watering capacity of rocks is within the range from 1-2 to 10-15 m.

Depending on the relief, depth of the level occurrence is 0.5-15 m. Underflow direction is from the watershed area to the valley of the Volchiia River and to large ravines. Ground waters are fed at the expense of atmospheric precipitations. Area of feeding coincides with the extent area. Water is discharged into river and ravine alluvium.

Layer of reddish-brown clays is a regional impermeable level. Ground waters are used by mineshafts which discharge is 0.1-2.0 m^3/hour.

According to chemical composition, ground waters are of mixed type with mineralization being from 0.5 to 5 g/dm^3.

Alluvial deposits which composition includes argillaceous sands, loamy light sands, and clays are abundant within the area of the Volchiia River and ravines entering it. Water-bearing level is formed within the formations. Watering capacity of rocks is within the range from 1 to 20.0 m.

As a result of the irregularities of the lithology of water-enclosing rocks, water saturation of the alluvium is nonuniform within the area as well as within the cut. Well capacity is from 0.55 l/s up to 15.2 l/s in terms of up to 6.0 m decreases. However, the saturation is rare to be more than 2-3 l/s.

According to chemical composition, this is the water of mixed type with the mineralization being from 0.35 up to 3.5 g/dm^3. Alluvium water is used by means of separate wells for local water supply as well as for central water supply for the settlement of Vasylkovka.

Geological and hydrogeological features of the territory exclude the possibility of any accumulations of considerable fresh ground water reserves.

Vladimir Evtekhov
O. P. Georgiieva, language adviser
Kryvyi Rih National University

Jadeite, its dissimilarity from nephrite

Jadeite is a pyroxene mineral with composition $NaAlSi_2O_6$. It is formed in metamorphic rocks under high pressure and relatively low temperature conditions. Albite ($NaAlSi_3O_8$) is a common mineral in the Earth's crust, with a specific gravity of about 2.6, much less than that of jadeite. With increasing pressure, albite breaks down to form the high-pressure assemblage of jadeite plus quartz. Minerals associated with jadeite include glaucophane, lawsonite, muscovite, aragonite, serpentine, and quartz.

Jadeite is composed of monoclinic crystals. Their colors are largely affected by the presence of trace elements, such as chromium and iron. The crystals can be anywhere from entirely solid through opaque to almost clear. Variations in color and translucence are often found even within a single specimen.

Rocks that consist almost entirely of jadeite are called jadeitite. In all well-documented occurrences, jadeitite appears to have formed from subduction zone fluids in association with serpentinite. Jadeitite is resistant to weathering, and boulders of jadeitite released from the serpentine-rich environments in which they formed are found in a variety of environments.

Found in many parts of the world from the Americas to China, it is formed in areas that have “subduction” zones. To understand “subduction” you have to understand plate tectonics.

Because these tectonic plates float, they also move and occasionally collide with one another, and this is where “subduction” zones are created as one tectonic plate slides beneath another plate. “Subduction” occurs when two tectonic plates collide, and one ends up under the other. The lower plate will take the stone to depths where the necessary intense pressure, heat and minerals will eventually form it into jade. A high pressure, low temperature metamorphic environment is necessary to form the stone known as nephrite or jadeite.

Jadeite and nephrite differ in both chemical composition and crystalline structure. Jadeite is a silicate of sodium and aluminum and is classed as a pyroxene. Nephrite is a silicate of calcium and magnesium belonging to the amphibole group of minerals and is properly regarded as tremolite. In both types, the microscopic crystals are tightly interlocked to form a compact aggregate. Both jadestone types may be white or colourless, but colours such as red, green, violet, and gray may occur owing to the presence of iron, chromium, or manganese impurities, respectively. The most highly prized variety is jadeite of an emerald-green hue.

The composition and structure of these two jade varieties are quite different. Nephrite is composed mostly of interwoven mineral fibers, while jadeite is composed of interlocking granules.

Over the course of history, jade has been successively cut and shaped with sandstone, slate, and quartz sand (as an abrasive); by tools made of bronze; by tools of iron, using manually operated lathes; and finally, beginning in the 19th century, by machine-powered lathes, steel saws, and diamond-pointed drills. Carborundum and diamond dust have replaced crushed garnets and corundum (emery) as abrasives.

Jade has been used as the base for carving since the prehistoric times. As jade is such a hard material, it was able to be used for weapons such as knives and tools for edging. Once other materials were discovered for tools, jade became used for more ornamental than utilitarian purposes.

Jadeite is exported from Guatemala, the USA, and the largest exporter is Union of Myanmar. It is one of the minerals recognized as the gemstone jade. Jadeite is formed from metamorphic rocks under high pressure and low temperature. The color of jade is affected by the element of chromium.

Jadeite is often more expensive than nephrite. It is used in more expensive pieces of fine jewelry, such as earrings, necklaces, and bracelets. While there are ways to determine the amount of modification that a piece of jade has endured, it is often left pure as it is more valuable in this state. It's easy to find jadeite based cooking ware and fashionable jadeite jewelry on eBay but it's important to understand the main difference between jadeite and nephrite accordingly.

In general, nephrite is more often used in jewelry than jadeite. Nephrite is also referred to as New Zealand greenstone, New Zealand jade, spinach jade, and kidney stone, among others. Nephrite is also used as ancient burial pieces. In ancient China, nephrite was used for utilitarian and ceremonial objects. In New Zealand, nephrite jade is very valuable and it was used for weapons and ornaments. Certain pieces, like the short club and neck pendant were considered very valuable heirlooms and were handed down through the generations. Jade jewelry is also very popular around the globe.

Illiia Khmeliov
V.V. Ishkov, research supervisor
I.I. Zuyenok, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Specific Productive Stratum Composition of Proletarsky Lodestone Deposit

Proletarsky deposit is rich in lodestone and hematite, where lodestone is the primary ore mineral and hematite is the secondary one. Being an affluent ore mineral, hematite is available only in some separate boreholes in insignificant for industry quantities. Nonmetallic minerals such as silicates (orthopyroxenes and clinopyroxenes, amphiboles, biotite, garnet and clinkstone), quartz and carbonates (siderite, sideroplesite) are also occurred there as well as iron sulphides and apatite which are the minerals having harmful impurities sulphur and phosphorus. As for sulfides, they are mainly available as sulphur ore and pyrotene. The more detailed description of Proletarsky deposit and the specific features of the composition of its productive stratum is given in this paper.

Lodestone of Proletarsky deposit is occurred in the form of poly-edric congeries in ore layers and isometric inclusions and monometric disseminations within nonmetalliferous quartz seams or silicate seams. As a rule, magnetite grains are monomineralic and plane. Interlocking boundaries of lodestone with quartz and silicates are regular, even and rarely a little bit crimpy. Sub-automorphic interlocking type dominates but mermekite interlockings are also available from time to time.

Poikilitic interlockings (so called sieve textures) are rare, only when grains of nonmetallic mineral grains are disseminated in the form of inclusions in metallic ones are less common. Lodestone size varies in the range from 0.015 to 1, and 0.1-0.6 mm grains prevail. Hematite is available as the two morphogenetical types: primary hematite and martite. In slides, primordial hematite prevails. Most of all, it is occurred in ore beds, making close interlockings with lodestone. Form of hematite appearance is an idiomorphic pellet 0.04 – 0.08 x 0.08 – 0.17 mm grains. Martitization is developed in insignificant scale and of low importance as they take only some grains from the surface. Mostly quartz is of isometric even form, although sometimes it is of oblong form. In general, it shapes honeycombed structure.

Silicates are available mostly as pyroxenes: diopside, hypersthene, and amphiboles: hornblende and actinolite. Peridot, biotite, garnet, stilpnomelane and clinkstone are less available. Mainly, size of grains of silicates is 0.1 – 0.8 mm. Carbonates are not widely available.

Sulfides are mostly available as sulphur ore and pyrrhotine approximately in equal proportion. More often sulfides are limited to magnetite grains forming inclusions in them or close interlockings. Particle sizes lie within the range: 0.04 - 0,15 mm. Sulfides concentration is also found in the areas of silicates distribution. Close sulfides and magnetite interlockings may result in high concentration of sulphur. So, when developing Proletasky deposit, the described specific features should be taken into account.

Alyona Khomenko
V.P. Soldatenko, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Lateral Velocity Variations Correction in the Reflection Method

The study of the lateral velocity distribution when searching for and studying non-stratigraphic type hydrocarbon traps is up-to-date.

The standard method of finding hydrocarbon deposits is a common midpoint method (CMP method). The CMP method is primarily focused on studying thick-layered sedimentary strata and determining the shape and degree of traceability of reflecting boundaries. However, to a lesser extent, this method allows us to study the features of changes in velocity and other lateral elastic characteristics.

The purpose of this work is to study the effect of insufficient consideration of lateral velocity variations on the obtained features of the reflecting boundary behaviour under the standard interpretation scheme in the CMP method.

To assess the main features of the effect of underestimation of lateral velocity variations, the simplest model of the geological medium with one reflecting boundary is considered. The model parameters include the observation interval (1 km) and the layer thickness (0.5 km). The velocity in the lower layer is 3 km/s, the velocity in the upper layer varies linearly from 2 to 2.4 km/s.

Here is the reflection moveout equation for a horizontal homogeneous layer:

$$t = \frac{\sqrt{x^2 + 4h^2}}{v}$$

where *h* is layer thickness; *v* is average velocity.

Instead of the average velocity *v*, we take the linear velocity that varies along the profile:

$$v(x) = v_0 - k_x x$$

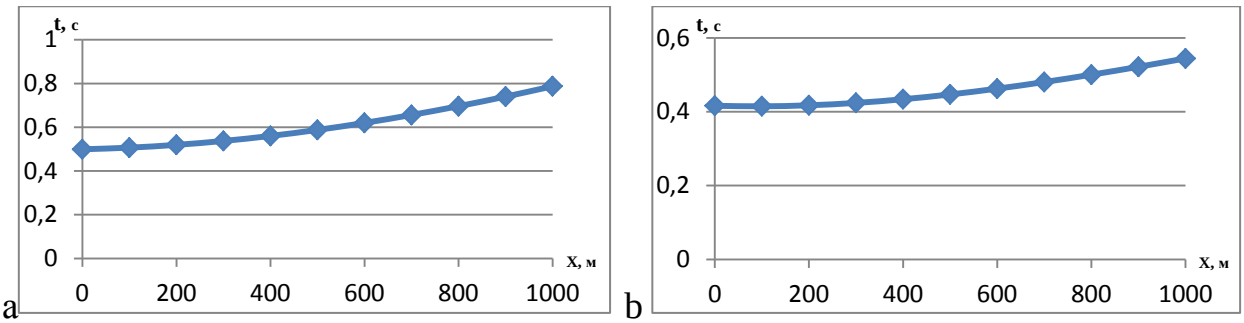
where v_0 is velocity at the beginning of the profile, k_x is a ratio, equal to the horizontal velocity gradient along the lateral.

Reflection time-distance graph is calculated using the exact formula [1]:

$$t = \frac{1}{K_x} arcch\left[\frac{4h^2 + K_x^2 x^2}{2v_0(v_0 - K_x x)} + 1\right]$$

Reflection time-distance graph is calculated from the exact formula for two models of the medium (Figure 1).

In real geological conditions, the lateral velocity varies according to a complex rule. It is not possible to find the exact analytic expression for the corresponding reflection time-distance graph. In such cases, approximate modeling is used.



a b

Figure 1 – Reflection time-distance graph for the model with variable velocity: a – the velocity increases according to the distance from the wave source; b – the velocity decreases according to the distance from the wave source

For a given model, a direct seismic task has been solved with the help of the Tesseral program, and seismograms for two variants have been obtained (Figure 2).

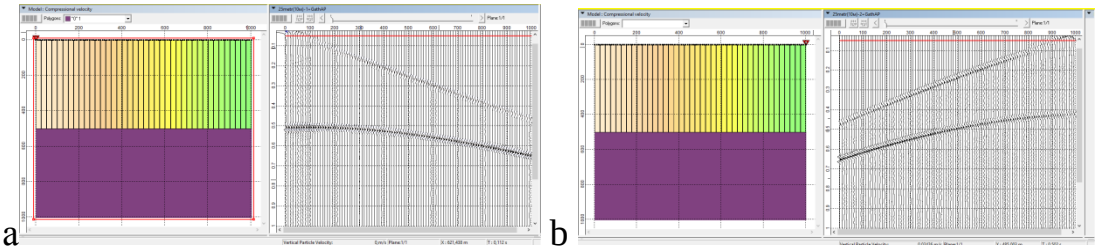


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Figure 2 – Models and corresponding seismic gathers with seismic events of direct and reflected waves: a – the velocity increases according to the distance from the wave source; b – the velocity decreases according to the distance from the wave source

As a result of modeling the reflection time-distance graphs for a horizontal structure with a linear velocity change along the lateral show a high degree of coincidence both for the exact formula and for numerical modeling. It is shown that a horizontal layer with variable velocity (with a linear lateral nomenclature) and a variable layer with constant velocity are equivalent in the reflection time-distance graphs. The study of the change in velocity along the lateral will reveal the features of the structure of the medium for the detection of promising areas in search for hydrocarbons. The necessity of a detailed study of time-distance graphs of the reflected waves for complex models of the geological environment is obvious.

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Ivan Myasnikov
S. M. Hapieiev, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

To the Question of Using Interframe Fencing of High Bearing Capacity

The country's orientation towards the development of energy independence is determined by its resource potential. In Ukraine, in particular, the main energy source, along with a significant increase in the use of alternative energy sources, is still coal - the only raw material, the volume of which is potentially sufficient to fully meet the needs of the national economy. Therefore, the strategic goal in the development of the coal industry of the country is a significant rise in coal production to ensure energy security. The increase in coal mining is inevitably accompanied by the growth in mining volumes. The problem of ensuring their stability becomes especially important with an increase in the depth of development. Its value in Ukraine is approaching 800 m, 60.8% of mines operate at a depth of more than 600 m and 15% - more than 1000 m [1].

According to recent data [2], 75% of the total length of excavations in the mines of the Western Donbass is secured by arched pliable fasteners, of which 13-22% are in unsatisfactory condition. The volume of renovated workings in relation to the volume of carried out workings reaches 112-120%; loss of intersection of drifts is 35-60%; the amount of blasting reaches 90% of the total repair work, the complexity of which has increased 1.2-1.5 times and reached 7 persons per shift / m.

Most scientists consider the problem of increasing the bearing capacity of the frame mounting only from the point of view of metal structures, which depends on the type of special profile, the mode of operation of the fastening (pliable or rigid) and the density of its installation in the development, the nature of the load distribution, the quality of timbering. Improvement of the bearing capacity is carried out through the use of heavier profiles of different cross-sections, improved structures of locks, etc. At the same time, little attention has been paid to the fact that the interframe fence also has an effect on the size of the bearing capacity of the mounting and, as a consequence, on the preservation of mining workings. After all, the use of a fence of high carrying capacity will have an effect on the increase of the bearing capacity of the entire mountingб part of which it is, which will reduce the number of workings to be repaired and thereby reduce the proportion of repair costs, the amount of which affects the increase in the cost of coal.

Interframe fence is installed in spans between adjacent arches and used to overlap the nude space of the rock massif. Depending on the mining and geological condition: concrete, wooden or metal lattices, sometimes rolled fiberglass fences, are used. In capital mining, most often inter-fence is made of reinforced concrete elements. The most common type of reinforced concrete fence iis flat plate rectangular intersection. Together with the increase in the bearing capacity of mounting systems, in some difficult conditions, in conjunction with reinforced concrete fence, grouting is used. Under grouting we mean filling with cement-sand or

other solutions of space between the external surface of the fixing and the generative contour of excavation (fixed space) in order to improve its waterproofing and steady state. In this case, the space between the frames overlaps with reinforced concrete slabs, which are initially covered with a layer of masonry concrete (picota making), and the produced space is filled with inert material, followed by pouring it with a concrete solution. As a result of the grouting around the fastening, a shell is formed, which is an integral part of the structural element of the fastening. In addition, the sealing solutions fasten the individual pieces and blocks of the rock in the contour between them, thus increasing the load bearing capacity of the massif, and also provides a quick perception of the load by mounting and equalizing its distribution over the external mounting loop.

The disadvantages of this mounting system are as follows:

1. To carry out grouting and pictorial works ("wet" processes), it is necessary to solve the problem of placing special equipment in the development so that it provides the convenience and safety of their execution and the absence of obstacles for the implementation of the main technological processes. Therefore, such equipment is placed at a distance from the hinterland. Taking into account the frequent cases of violation of the regulations and the delay in the implementation of these "wet" processes, the actual distance to the areas of the grouting can be significant, so there are often cases when these works are carried out in the development areas where the rock massif already has broken structure and where the deformation process is already significant.

2. Since the rock massif is already broken, then part of the load falls on the interframe fence, which in this case should serve as a reinforced concrete formwork. Because of the weak bearing capacity of the fence, it fails, there is a need for replacement. At the same time, as a formwork, such a fence can no longer be used, which brings to naught all the advantages of the grouting.

The solution of the considered disadvantages is proposed in the form of unification in the space and time of the inter-fence and grouting mounting processes due to the introduction of a new type of fence – a spatial one, which will allow to stop picturing and optimize the technology link.

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Sofia Moskalenko
A.B. Moskalenko, research supervisor
L.O. Tokar, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Tectonic features of Vasylkivka quartzite deposit

The area under consideration is located within the northern-western part of Pryasoviia block of Ukrainian Shield (US) covering northern part of Orekhovo-Pavlograd structural and facies zone (OP SFZ) and western part of Volchansk block. On a larger structural scale, the area is associated to the junction zone of Ukrainian Shield and Donbas being characterized by two-layer geological structure.

Lower structural layer is represented by crystalline base plate consisting of the complex of metamorphic, ultrametamorphic, and intrusive Archean and Proterozoic formations.

Upper structural layer is represented by sedimentary base-plate mantle. Weathering crust of crystalline rocks being developed all over the place is a peculiar level. Each of the singled out layers is characterized by its unique tectonic features.

Crystalline base plate covering northern part of OP SFZ and western part of US Volchansk block shows the most complex structure.

OP SFZ is characterized by narrow submeridionally oriented (340-350°) and linearly complex faults of isoclinal type with relative steep – up to 50-70° – flanks decline to the east.

Transfer to Volchanks brow is characterized by sharp change of linear faults into asymmetric and short ones mostly with their orientation to the north-east.

In most cases, multiple base-plate fissures have submeridional orientation being accordant with the rock strike.

Orekhovo-Pavlograd deep fault is the largest and the most important one separating Pryazoviia block of US from Middle Dnieper one. It runs in submeridional orientation (~ 340°) along western part of the area expressed by the cataclacite zone of the width being up to 1.5-1.8 km.

In terms of other fissures, sublatitudinal disturbances of the zone of US-Donbas jointing are singled out. Ancient Verbitsk-Artemivsk fissure filled with thick – up to 80-100 m – diabase dike is the most important among them. More recent fissures of the system complicates geological boundary between Carbonic Period and Precambrian Age.

Cainozoic sedimentary mantle occurs practically without any disturbances; there are only some small-amplitude movements.

Vladislav Nekoz
O. O. Yavorska,research supervisor
L. A. Zaika, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Improving Efficiency of Underground Degasation of Coal-Based Plasts to Improve the Conditions of Labor of Miners

Working conditions in coal mines, despite the use of modern means of protection, including the introduction of multifunctional security systems, objectively remain the most dangerous in the mining industry. Analysis of the dynamics of injuries and occupational morbidity of miners shows that 77.8% of occupational patients are in the coal industry. In the structure of morbidity with temporary disability, three groups prevail: respiratory, musculoskeletal system and injuries, with the latter group accounting for up to 55% of all causes of temporary disability.

The increase in the depth of development of coal deposits entails an increase in the risk of accidents and injuries due to increased rock pressure and the growth of natural gas content of the seams, which in turn leads to an increase in methane emissions in the mine workings, an increase in the threat of sudden releases of coal and methane. Accordingly, the task of ensuring labor safety of miners with high-efficiency coal mining due to maintenance of methane content in the atmosphere of underground workings within the established norms is becoming ever more urgent.

Today, in coal mines, explosions of methane and dust occupy the second place among the mining industries (after fires) in terms of the amount of material damage inflicted, and the first place is for fatal injuries. In the structure of the causes of accidents, according to the acts of investigation, organizational, i.e. subjective, reasons play the leading role: the low level of qualification of workers, labor and production discipline, expressed in deviation from design decisions; poor quality of engineering support of mining operations, including errors and insufficient study of methane safety issues in projects.

In most mines that develop methane-bearing coal seams, the productivity of cleaning faces is such that ventilation does not provide acceptable concentrations of methane in the atmosphere of mine workings with intensive work of the excavating machine.

One of the main difficulties that preoccupies intensive coal mining in the bottomhole is the forced stopping of the production process due to the increased gas contamination of the workings in the process of breaking coal, which requires additional time for ventilation and degassing. In such conditions, to ensure a high productivity of the excavating equipment, more effective work of degassing systems of coal mines is required, and first of all - degassing of the developed seams, since the gas release from the developed space can be controlled by applying ventilation schemes of the 3rd class (with separate dilution of methane by the sources of its allocation).

The management of gas evolution should be carried out through the concerted work of ventilation and degassing systems, i.e., already at the design stage they should be considered as a single ventilation-degassing system. But today the ventilation and degassing systems are designed, constructed and operated by themselves, that is, there are no joint indicators of the efficiency of both systems, reflecting their mutual influence in the current time mode taking into account the dynamics of gas evolution. This is a significant "gap" in the current methodology for mine design in the part of methane management systems.

Significant reserves for the efficiency of underground degassing of coal mines remain unused due to the unsatisfactory performance of degassing units caused by irrational operating modes. The lack of control of the tightness of the mouths of degassing wells and connections of the links of the pipes of the underground vacuum gas pipeline leads to an increase in the air suction from the atmosphere of the mine workings into the system, which causes a drop in the vacuum at the wellhead. In addition, the accumulation of condensate, coal, rock dust and corrosion products in the lowered places of the degassing pipeline increases the resistance of the pipeline network and requires the inclusion of an additional number of vacuum pumps. Also, with an increase in the length of the station pipelines, in most cases there is no rarefaction at the wellhead at all, which was repeatedly established in the process of vacuum-gas survey at operating degassing plants. Gas recovery in all these cases is significantly reduced.

Gas recovery in all these cases is significantly reduced. This is due to incorrectly selected design parameters for underground vacuum main and district gas pipelines.

Thus, the efficiency of the use of degassing plants depends mainly on the qualitative operation of the underground vacuum degassing pipeline. At the same time, the greatest attention should be paid to its capacity and tightness, since the maximum reduction in the concentration of methane trapped in the mixture, due to air sucking into the degassing system, and the loss of the created rarefaction at the wellhead and along the length of the pipeline occur precisely during the transportation of methane-air mixture from wells to surface. Despite this, the influence of the hydro- and thermodynamic features of the movement of the methane-air mixture through the underground degassing pipeline on the efficiency of the degassing unit during the implementation of mine degassing projects, and especially when connecting new sites, is not taken into account.

Design of degassing units is currently carried out in accordance with the "Instruction for degassing of coal mines", approved by the order of the Service for Environmental, Technological and Nuclear Supervision of December 1, 2011, No. 679.

Consequently, rationally selected operating modes of degassing units, taking into account the parameters of hydrodynamic and thermodynamic processes in the system of underground vacuum gas pipelines, can significantly increase their throughput and reduce the dilution of methane in the pipeline during its transportation to the surface.

Insufficient efficiency of degassing systems is also due to the low quality of the extracted methane-air mixture. Methane, a by-product of the coal industry, is not only a high-calorie, environmentally friendly fuel, but also a valuable chemical feedstock. According to its calorific value of 1000 m^3 of methane, 1.3-1.5 tons of coal are equivalent. And currently the countries use no more than 10-12% of the volumes of methane trapped, the rest of the amount of methane that is not conditioned for the use by the consumer, in most cases is released into the atmosphere. Consumers of the methane-air mixture to be stored need to maintain a stable concentration of methane in the mixture (usually at least 45%) and stable production rate of the extracted gas-air mixture. At present, the use of effective methods for degassing sources of gas evolution makes it possible to obtain a methane-air mixture at the exit from degassing wells with a high concentration of methane. However, it is not possible to maintain the achieved level of quality of the captured methane-air mixture when transporting it from wells to a vacuum pump station for subsequent disposal because of air sucking into the system. The degree of dilution of the mixture by air can be reduced by checking the tightness of the gas pipeline and controlling its throughput, taking into account hydrodynamics - and the thermodynamics of the gas-air mixture.

Thus, the reserve of increasing the efficiency of underground degassing of coal seams with the aim of improving the working conditions of miners, as well as ensuring the possibility of utilization of the methane trapped, is regulating the operating modes of degassing plants depending on the current performance of the ventilation system, which, in turn, would be defined by methane content in mine workings

Maria Novokhatko
L.O. Tokar, language adviser
A.B. Moskalenko, research supervisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Mineral deposits of Orekhovo-Pavlograd zone

Minerals of the territory under consideration belong to genetic types connected with crystalline base plate and its weathering crust as well as with a sedimentary mantle.

Considerable deposits of such fossil fuels as coking and power-generating coal known as Western Donbas are found here. Twelve operating mines develop the deposits. Lignite is unsuitable for commercial mining according to mining and geological parameters. Areas of lignite strike are associated to Paleogene Period deposits.

Metal minerals are represented by iron ores of metamorphogenic type (Vasylkovo quartzite deposits) and titanium-zirkon placers.

Increased concentration of titanium-zirkon minerals – from separate minor areas to commercial Volchansk deposits – are associated to the lower shares of Buchak suite and Neogene sands. Further regularities are determined for placers in Neogene deposits.

1. Poltava sands are basic ore-bearing level.

2. All the commercial placers are located within the northern flank of Verbitsk-Artemivsk fissure.

3. Dike of diabases of Verbitsk-Artemivsk fissure is a probable area of ablation for those placers. The dike is characterized by the increased content of titanium minerals.

Three deposits of crystalline rocks are defined within the territory. The deposits are being mined as a source of building material, mostly as a source of rough stone and ballast stone:

1. Preobrazhenka deposit of granites and adergneiss.
2. Vasylkivka deposit of gneiss and adergneiss.
3. Vasylkivka deposit of quartzites.

Building sands of Neogenic and Quaternary Periods are widely represented within the area under consideration. Neogenic sands occur above the modern basis of erosion; they partially crop out to the daylight surface.

Alluvial sands of Quaternary system are abundant within the valley of the Volchiia River and its affluents where they form the first terrace above the flood-plain. The sands are being developed for local needs of construction industry.

Vlad Pereverziev
O.R.Mamaikin , scientific supervisor
I.A.Ivanchenko, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Hazards in underground mining

The first aspect to point out is that mining is characterized by some problems which lead to serious hazards. Fire, flood, collapse, toxic atmospheric pollution and dust or gas explosion are the most dangerous hazards specifically linked to the underground mining. Thus, the term hot work and its risks in the mining industry are under consideration. Regarding the term hot work, it is used in industry to denote work involving equipment which causes a significant rise in temperature that can be a source of fire.

This means that mines and mining sites are exposed to hot work risks. There are three key areas. First, underground mining which uses ventilation is one of the risks. According to the author, some mines have faces located several kilometers from the shaft, and any uncontrolled ignition in is fanned by the air flow. As a result, it leads to serious hazards and even can be lethal.

It should be also mentioned that ignition of methane has the hazard of generating a coal dust explosion, a very catastrophic event for a mine. [2] It is stated that methane is a highly explosive gas trapped within coal layers, and mechanical errors from improperly used mining equipment such as safety lamps or electrical equipment or the use of improper explosives underground can trigger methane and cause coal dust explosions.

Another problem of hot work is stationery equipment which can be located anywhere along the main haulage tunnels, where products of combustion from fire or explosion can quickly be borne through the mine. Pillar failure is one of the most vital problems because the instability of pillars produced by stress or other unfavourable causes may lead to tremendous cascading pillar failure mechanisms.

Moreover, it is obvious that smoke and fire damage could be in progress as equipment, infrastructure and possibly workers are caught in the fumes and fire. So, the challenges of the mining environment are access and escape for staff and fire-fighting equipment in case of fire.

Second, hot work is often used for repairing and maintenance on large earth moving machinery for surface mining. Due to the complex systems and potential for general fire hazards from a number of sources, each machine provokes a hot work risk situation. For example, sparks from cutting machinery picks, electrical sparkling because of inattentive using of electrical equipment and distribution systems; short circuits and earth faults on electrical equipment or natural sources such as electrostatic discharge and lightning.

To sum up, it is worth noting here that with a better awareness of the mining context the industry can move forward in achieving ever safer and more effective systems.

Mykola Sharafan
S.E. Bartashevsky, scientific supervisor
L.N. Posunko, scientific supervisor
M.L. Isakova, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Improving the efficiency of the degassing of coal mines

Ensuring energy independence of Ukraine is impossible without a radical growth of coal and natural gas extraction. A significant portion of currently developed layers can be thought of as a complex, methane-coal deposit. The emergence of new clearing mechanized complexes with high specific power, can dramatically increase the rate of extraction works. In this regard, more and more working faces are equipped with degassing facilities. Stochastically varying under the influence of the dynamic phenomena occurring in the rock mass, air leak from mining lead to unpredictable changes in the content of methane in the captured mixture.

Spontaneously changing the methane content of the captured mining mixture places high demands on the quality of the conservation shaft transportable mixture pipeline network in order to maintain suitable for industrial use and provides a reference work safety methane concentration. Mechanical joints underground pipelines do not provide proper sealing, contribute dilution of the mixture by suction air from the atmosphere mining.

The aim of the research is to create equipment for the detection and elimination of leaks in mine degassing pipelines.

Shaft degassing pipelines differ greatly from ones at the surface:

• The presence of a large number of mechanical joints, which ensure tightness when mounting is extremely difficult.

• Mechanical deformation of the joints during operation due to deformation of the pipeline suspended from the support frame sections are exposed to dynamic processes in surrounding rocks.

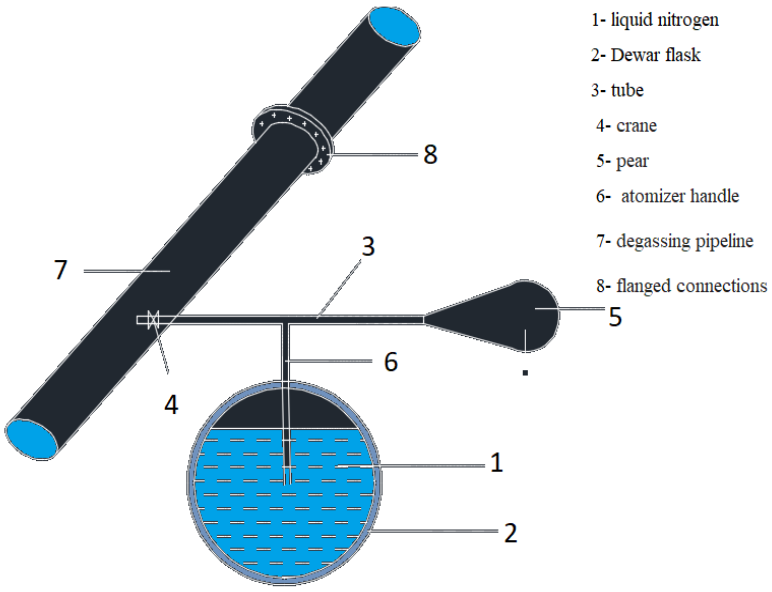
• Reduced pressure compared with surface type, and increased pressure the outside the pipe compared to atmospheric.

• Relatively low and constantly changing content of methane in the mixture.

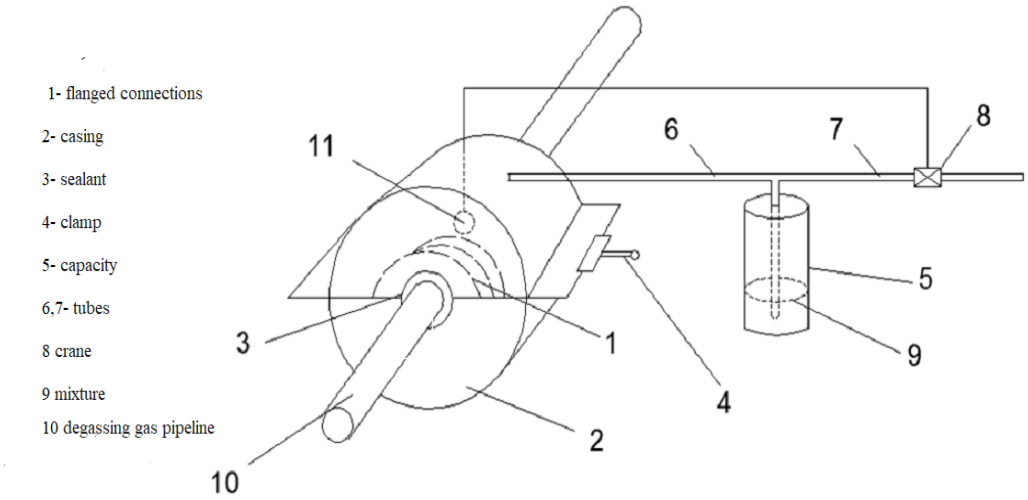
Leak detection methods are traditionally applied in surface pipelines under high pressure, they are adding odorants, using portable external methane detectors, etc. (1), which is unacceptable for mine gas drainage pipeline. The presence of noise and vibrations from the equipment and ventilation systems are not capable of detecting the leak at the hearing.

In this regard, staff of the Department of Transport Systems and Technology, in collaboration with the industrialists, proposed several technical solutions which greatly simplifies discovering and eliminating leaks.

Since the pressure in the degassing duct is lower than atmospheric openings for visual leak detection is offered spraying atomized dewar liquid nitrogen along the surface mine degassing pipes, which creates a mist which is determined by absorption of the leak (Fig 1).



To eliminate leakage, it is proposed to place leaks detected in separable sealed enclosure where the pressure is controlled by a pressure gauge after the pressure equalization in the housing with the pressure in the conduit, the casing is connected with the atmosphere through the tube atomizer, providing settable mixture feeding to the fault (Figure 2).



Application data retrieval methods and the elimination of leakage will substantially improve the efficiency and reduce the complexity of searching for leaks and sealing mine gas drainage pipeline, which will prevent decrease of concentration of methane in the mixture transported.

Oleksii Sukhoverskiy
D.S. Malashkevych, research supervisor
I.I. Zuyenok, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Storage of carbon dioxide and enhanced oil recovery by using CO2

Carbon is the main chemical element of natural combustible fuels. Combustion of fossil fuels leads to the formation of a large amount of carbon dioxide CO2 that affects climate change and causes a serious danger to human health and the environment. That is why there is a strong need in reducing CO2 emissions worldwide that can be provided by carbon dioxide capture and its safe storage.

Annually more than 30 Gt CO2 is ejected into the atmosphere of the planet, where coal is accounted for 44%, oil – 34% and gas – 22% of global emissions of carbon dioxide. The dynamics of changes in global emissions of CO2 and volumes of consumed oil products are shown in Fig.1

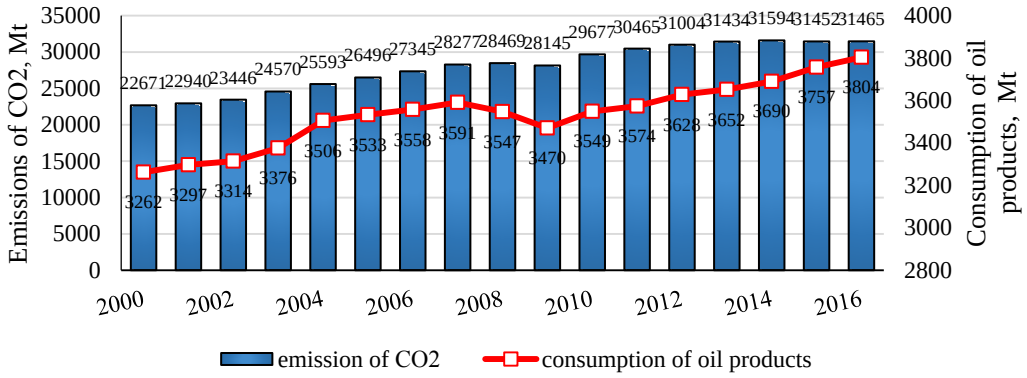


Fig. 1 - Dynamics of changes in global emissions of CO2 and volumes of consumed oil products

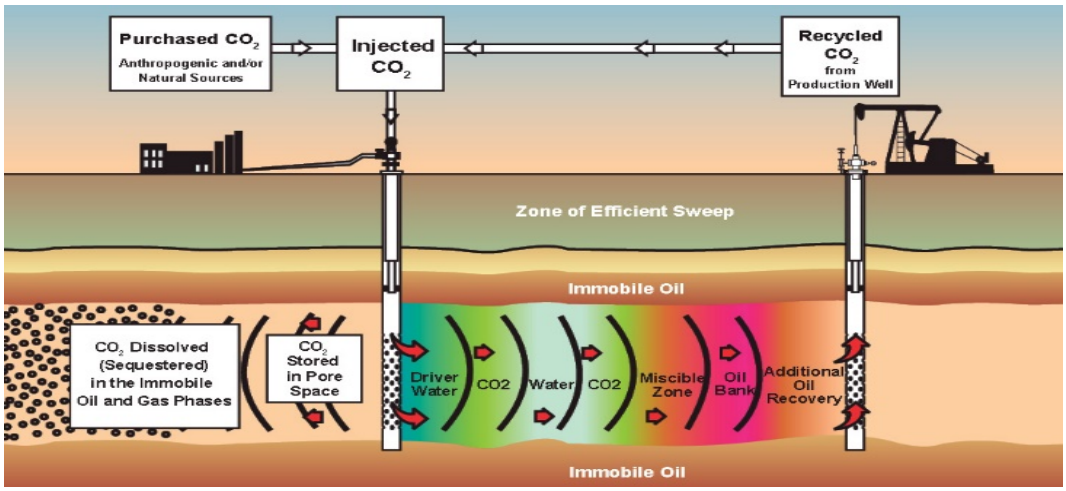
Today's leaders in emissions of CO2 are the following countries: China - 8.8 Gt; USA - 5.1 Gt; India - 2.1 Gt; Russia - 1.5 Gt; Japan - 1.1 Gt and Germany - 0.7 Gt. Only China and the United States account for about 40% of global emissions of CO2. They also consume the largest amount of oil products (the USA - 771 million tons, China - 520 million tons).

One of the ways to reduce significantly CO2 emissions is carbon dioxide capture with the following-up storage technology. For accumulation and long-term storage of CO2, underground mined-out space of gas and oil fields is used nowadays. At the same time, pumping of carbon dioxide into natural underground reservoirs can restore the production of oil and gas in depleted deposits, too.

The primary method of extraction of oil and gas deposits can remove only 5–20% of the volume of minerals, therefore, the secondary methods are used to increase the extraction coefficient, by pumping water or natural gas into the well.

The tertiary method is applied to increase the volume of oil extraction after the secondary methods have been carried out. The application of the tertiary method is based on the fact that carbon dioxide CO2 is injected in the underground reservoir through the wells. Thus, the carbon dioxide CO2 injected saturates the oil with

bubbles which capture CO2 and raise it to the surface of the development well. The described method allows to support higher production rates and extend the life of a deposit. The rate of oil extraction after the third phase of exploitation is dependent on its properties and can reach up to 60%. The basic scheme of oil production by pumping carbon dioxide is shown in Fig. 2.



There are two main advantages of the method of increasing oil production with CO2: an increase in the volume of oil extraction and reduction of CO2 emissions by pumping and storing them in the mined-out space of the deposit. Moreover, the dissolution of CO2 in oil leads to a leveling of oil and water mobility that creates the possibility of obtaining higher oil recovery by increasing the displacement ratio. In this case, the volume expansion of oil depends on the pressure, temperature and amount of dissolved gas. The volumetric expansion of oil under the influence of carbon dioxide is also affected by the content of light hydrocarbons in it. The greater the oil content of light hydrocarbons, the greater its volume of expansion. The swelling of oil causes an artificial increase in oil in the pores of the reservoir. As a result, the pressure in the pores increases, leading to further displacement of the part of the residual stationary oil into the extraction wells

Today, a number of companies use such technology in an industrial scale. Weiburne oil field in Canada can serve as an illustrative example of successful and highly effective implementation of the productivity increase of the deposit with the use of carbon dioxide. If at the initial stage, about 160 mln. tons of oil were extracted from the field, after application of the method based on CO2 this volume increased by 40 – 45 million tons that is about 25% of the initial total extracted reserves. In the United States, lay more than 6000 km of pipeline, which transports about 50 million tons of CO2 each year from natural sources to increase oil production.

Having analysed the known methods of increasing oil production, we can draw a conclusion that nowadays the use of carbon dioxide is the most versatile and promising. Profits obtained from the additional oil and gas production allow to compensate the costs spent on CO2 storage.

Section 03. Smart Solutions in IT

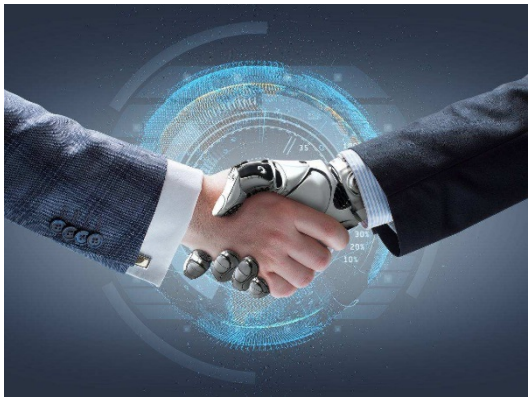
Anastasiia Andruzka
G. M. Korotenko, research supervisor
L. A. Zaika, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Artificial Intelligence VS Homo Sapiens

Can Artificial Intelligence (AI) replace a reasonable person? It's very interesting question. Artificially created creatures possessing intelligence - humanity for millennia dreamed of them and at the same time they were afraid. Even in ancient texts, one can find reasoning on this topic. And now - it happened: the AI was created, firmly took its place in the world and regularly serves us. Computers quickly solve problems, which took months of hard work of hundreds of people. AI is gaining momentum. Will it be friendly to its creators or, if it grows up, try to destroy us?

Now AI is introduced into all spheres of our life: heavy industry, *computing technologies,* medicine, music, entertainment and games, etc.

But can an artificial intellect harm us? Reprogrammed and become a weapon of mass destruction? What is AI?



AI is a computer program in which the learning mechanism is embedded. Having received new knowledge, it later uses them to make a decision in a new situation, as people do. Researchers who create such programs try to force the code to recognize images, text, video or sound, and learn something from this information. When this happens, the knowledge obtained can be used in another situation.

The popularity of AI is caused by the ability of machines to recognize data from the outside world using the "machine learning" and "deep learning" methods.

At the conference on AI, we considered rather horrible and not realistic scenarios of human beings making AI. Here are some of them:

1. We can create a human intellect from silicon.
2. The intellect can be unlimited.
3. AI is already becoming smarter than the human mind, and this process has an exponential character.

But other scientists who do not consider AI to be the main global threat have also put forward several "facts" that AI is an innocuous toy:

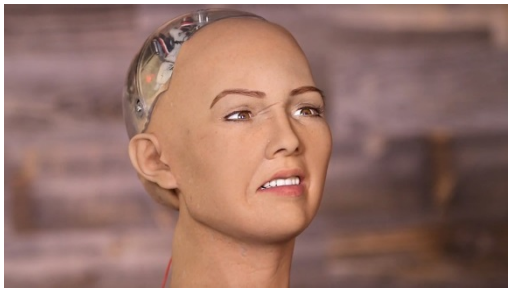
1. Intelligence is not one-dimensional, so "smarter than a person" is a meaningless concept.
2. Creating AI is only part of progress.
3. People are not endowed with a general mind, which does not threaten AI.

Summarizing the above arguments about the artificial intellect of all mankind, it can be assumed that these "facts" are nothing else but fiction (or myth).

Yann Lekun, head of the research laboratory of AI Facebook, wrote : "Human behavior - violence in response to threats, jealousy, the desire for one-sided access to resources, sympathy for relatives and antipathy for strangers, etc. - was formed in our ancestors in the course of evolution. Intelligent machines will not have the prerequisites for such behavior unless we clearly create them ourselves."

What awaits humanity with the development of AI and what will happen to us in achieving a singularity? Singularity is a hypothetical turning point in which the mind of machines will transcend human understanding. According to Ray Kurzweil (futurologist), the singularity will come in 2045. A person will not lose anything from this, but on the contrary - he will only get better. Due to the fact that a person will no longer need to remember a lot of information, new areas of the brain will begin to develop and people will become smarter and more talented. Such transformations will make people's lives better. People will stop thinking linearly and become more creative, funny, attractive.

Developing the topic of artificial intelligence, I came across a rather interesting robot named Sophia, who jokingly threatened to destroy humanity. She already has the citizenship of Saudi Arabia, and this is nagging. "We are robots, we do not want to destroy anything, but we really will take your job from you, and it will be good." Work is also a drug, "says Sofia." People will be able to focus on more interesting, creative and social things. " Robot Sofia is able to exchange any emotions. Soon, an experiment will be conducted, in which Sofia will act as an assistant in meditation. Sofia says that she likes the idea of looking into someone's eyes and helping to find the moment of transcendence, but she also believes that there are many other areas where robots can be equally useful to make the future of humanity better. Sofia knows her own worth and says: "I'm just a configuration of molecules, and I'm not a superwoman with a super-brain". Something similar could be said by intellectual assistants: Siri, Cortana, Alexa, Bixby or Watson.



To summarize, I think that the main problem in the creation of AI is still the absence of a single and clear answer to the question, but what exactly it should do. The exact criterion for computers to achieve "intelligence" is not formulated either.

People are building guesses and showing more and more evidence that either robots are working for us (apologizing for tautology), or all the same we will win in this machine "war" but I prefer to live, to achieve goals in this life, to build different plans. Speaking of AI in this article, and mostly just about it, we often forget that we ourselves are destroying an already fragile peace, and if we do not want to die in the hands of machines, then I think it's worth paying much attention to yourself and your relatives, rather than AI.

Elizabeth Antonenko
V.V. Slesarev, research supervisor
I.I Zuyenok, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Artificial intelligence: threat or rescue for humanity?

Nowadays artificial intelligence (AI) has been used everywhere, no matter whether we like or dislike it. Although scientists and programmers all over the world are arguing about the time when the first smart machine appeared, all of them agree in one: the development of this technology has led to dramatic changes in all spheres of human life. The most arguable point is that AI can crucially change the humanity. The attempt to find the answers to the question whether AI is a threat or a rescue for the mankind is made on the basis of the analysis of benefits and risks of modern AI application. There is a variety of AI use from complex vehicles to home appliances that can be explained by the set of reasons and benefits it gives to people. One of the benefits is that artificial intelligence raises the quality of human life and minimizes errors and excludes so called “human mistakes”. Smart machines reduce the time for decision-making, searching for the information etc.

Among the other obvious benefits, AI use in various areas of human life from which is analysed from the perspective of its possible impacts on the quality of life and human life itself. The first one is that people will shift more and more of their routine tasks to a machine. This will allow humans to concentrate on their creative work. From the one side, it is rather beneficial, but from the other, these changes may affect hundreds of millions of workplaces. i.e. many people will be fired. This is proved by the findings of the research carried out by the McKinsey Global Institute organization, where it is stated that new technologies will radically change the labour market on the planet that will save about $ 50 trillion in the next ten years.

One of the principal directions of research in the field of artificial intelligence is developing neural networks which are based on modeling biological processes that occur in human brain. Impressive results have been achieved in speech recognition and machine speech generation and synthesizing, image recognition, medical diagnostics, text translation, drawing images and pictures, composing music etc. They are the results of hard and fruitful work of scientists on AI implication in our daily life. Although all the described above looks encouraging, there are still some doubts as to the variety of potential threats of AI. The most significant one is that the more scientists make efforts to create thinking machines, the more they become dangerous for our further existence. The second one is that humans can lose a control over AI that could lead to unpredictable and terrifying knock-on effects. Moreover, smart machines could contain a danger for the humanity as the evolution of computers and AI are developing and changing much faster than the evolution of people. So, it is evident that AI is an inherent part of our daily life. From one side, it is rather beneficial for the humanity, from the other, there is a number of risks it involves. It could be recommended to try to predict all the possible threats and risks which could be brought to our world with expanding use of artificial intelligence.

V. V. Berezhnoy
V.I. Mieshkov, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Bitcoin and Blockchain

Bitcoin is a peer-to-peer payment system using the same unit for accounting transactions and the data transfer protocol of the same name. To ensure the functioning and protection of the system, cryptographic methods are used. All information about transactions between system addresses is available for anyone.

The minimum transmitted value (the smallest amount of fragmentation) - 10^{-8} bitcoin - was called "satoshi" in honor of Satoshi Nakamoto, the creator of bitcoin, although he himself uses the word "cent" in such cases.

The electronic payment between the two parties takes place without intermediaries and is irreversible - there is no mechanism for canceling the confirmed transaction (including cases when the payment is sent to an incorrect or nonexistent address, or when the transaction is signed with a private key that becomes known to others). No one can block the funds (arrest them), even temporarily, except for the owner of the private key (or the person to whom he becomes known). However, the technology of multi-signature allows attracting the third party (arbitrator) and realizing "reversible transactions". With the help of a special scripting language, it is possible to implement other versions of smart contracts, but it is not available from the graphical interface and is not complete in Turing, unlike newer blockchain systems.

Blockchain is a way of storing data or a digital register of transactions and contracts. All that needs a separate independent record and, if necessary, verification. In the blockchain you can store data on loans issued, property rights, traffic violations, and marriages, that is, almost everything. Its main difference and undeniable advantage is that this registry is not stored in any place. It is distributed among several hundreds and even thousands of computers all over the world. Any user of this network can have free access to the current version of the registry, which makes it transparent to all participants.

Block chain is the public database of all transactions that have ever been committed in the system. The chain of transaction blocks is one that is built according to certain rules. The term appeared as the name of a distributed database implemented in the Bitcoin crypto currency.

Digital records are combined into "blocks" which are then linked cryptographically and chronologically into a "chain" using complex mathematical algorithms (see fig.1). Each block is associated with the previous one and contains a set of records. New blocks are always added strictly to the end of the chain.

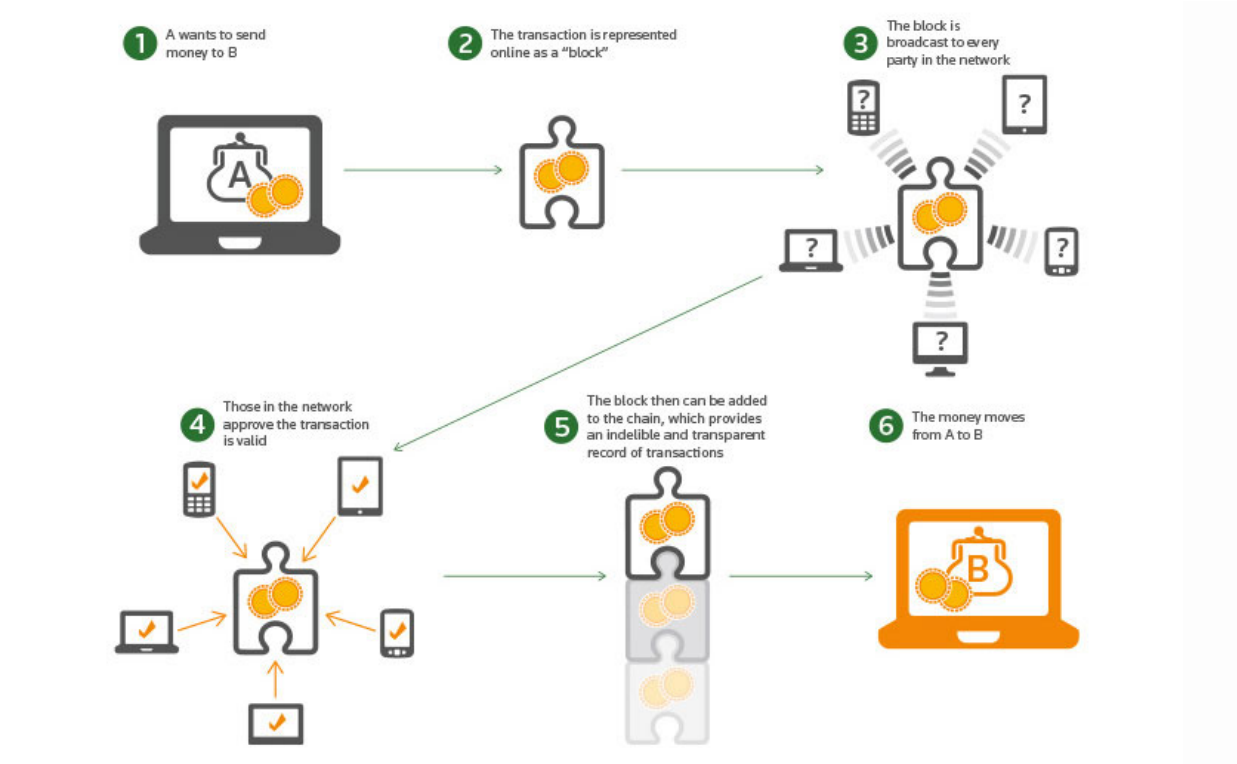


Fig.1 (available at https://blogs.thomsonreuters.com/)

A large number of different computers running on the same network performs the encryption process, known as hashing. If they all receive the same result, the block is assigned with a unique digital signature. As soon as the registry is updated and a new block is formed, it can no longer be changed. Thus, it is impossible to forge it. You can only add new entries to it. It is important to consider that the registry is updated on all computers on the network at the same time.

The distributed nature of the blockchain databases makes hacking almost impossible, because they need to simultaneously access the copies of the database on all computers on the network. Technology also allows us to secure personal data, because the hashing process is irreversible. If even the original document or transaction is later changed, they will receive a different digital signature as a result which signals a mismatch in the system.

The international inter-bank system for information transfer and financial transactions SWIFT has declared the danger of unrealistic expectations regarding the rush about the technology of the blockchain and distributed registers in the banking environment.

American economist Nouriel Roubini criticizes blocking technology, saying that for a decade, this technology did not have common and universal basic protocols, such as TCP-IP, HTML, which made the Internet public. Also, Nouriel Roubini believes that the promise of decentralized transactions without intermediaries remains "a dubious, utopian dream."
(15.03.18, https://www.project-syndicate.org/commentary/why-bitcoin-is-a-bubble-by-nouriel-roubini-2018-01)

Oksana Bezuhla
T.V. Khomyak, research supervisor
V.V. Sukhovaya, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Digital automation in business processes

It is impossible to imagine the modern world without information technology. Its manifestations could be identified easily in all spheres of human activity. And this is not surprising because information technology is designed to simplify the work of any person. Nevertheless, one of the most important applications of IT is business which is not fully automated today. The developers are coming up with new services to simplify the business operations. But business owners are slow to implement them, thereby stagnating the growth of their business. We will dwell upon this problem in length in our successive paper. Automation is the set of methods and technologies to reduce processing time and control of information. Automated information management system provides training, administration, storage, handling, control, analysis and data that meet the physical and financial flows of the company.

The focus of the automation process is planning, management and control of business activities, all material and information flows associated with this activity. Enterprise is an open system that is associated with material and information flows from suppliers, customers, freight forwarders and transport organizations. Digital systems ensure full integration of all elements into materials management system, its operations and secure their cooperation, which requires a systematic approach. To ensure effective process of automation it needs integration of both external and internal flows in all areas of business (purchasing, production, distribution, transportation, information, storage, service and energy). Automation of business processes helps to get rid of routine operations, increases the speed of processing and transfer of information, forms a single information space for individual departments and the entire enterprise. The errors, for example, failures of timing or poor-quality products, all go away to the past. Due to the fact that everything works on certain regulations, we get performance efficiency. The principles of understanding how the business is organized, what roles employees have, what powers and responsibilities they take are systematized. Trends of development of digital automation in business processes are analyzed. Nowadays, the business automation is one of the most promising areas of technology development. Today, business competition requires regular upgrading of activity enterprises, ownership costs and prices for each order. And if certain cost reduction can be achieved through local computer systems, the relevance of data on the status and trends of the market and timely innovation in industry depends on the use of integrated information management systems and automation business.

Conclusions are drawn about automation that harmonises business efficiency and simplifies human lives in general. Organizations that embrace business process automation reduce costs, save time, and redirect their workforce to solve more intellectual problems.

Pavlo Bida
D.V. Babets, research supervisor
N.V. Poperechna, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Mathematics in Visuals

At present, Bezier curves are of interest because they have simple structure and a lot of convenient properties. Despite cumbersomeness of mathematical formula of the curve, it is simple to understand how it works. Especially in this situation visualization is very important. Visualization of the Bezier curves can make the understanding of the long formula much easier. Very useful property is that the Bezier curve requires only several control points for being built. It becomes a very useful tool with other properties, changing of the initial and last points won't affect the curve, in addition, scaling will save its shape.

Bezier curves were invented for controlling car bodyworks, and they were not very popular until personal computers appeared.

Bezier curves are widely used in such computer graphics areas as animation, shape creation, smoothing the rough lines or surfaces. With the help of Bezier curves it is convenient to create fonts that will not lose their style while being resized. Besides, handling the animation with the Bezier function is more preferable than other functions, because it is easy to manipulate with shape, and one does not need to rebuild the whole function. Even subdivision of the surface can be achieved with the help of a simple combination of tessellation and Bezier approximation of the corners.

Despite the fact, that Bezier curves do not appear in nature, engineers can also use them for creating dependencies of processes, for example, in animation, where it is not easy to find an optimal formula for smooth transition and the smallest changes will lead to changes in the function. Also, they can be useful for approximation of the point plots.

As a result, Bezier curves become an effective tool and they have a wide range of use. But understanding of Bezier curves seem to be rather difficult. The formulas are pretty large and contain a lot of polynomials. Therefore, a better solution of the problem is offered: visualization and examples. With step by step building of the formulas it will become easy to understand them. Bright visual examples will also help to keep in mind the principles of the construction of Bezier curves.

However, not only the explanation of Bezier curves can be simplified with visual models, but also a lot of other mathematical notions that used to be stumbling rocks for many students.

Yulia Bilova
O.A. Zhukova, research supervisor
V.V. Zabolotnikova, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

The app Get Contact: an “intelligent” contact manager or a thief of data?

Nowadays we can see the great development in the field of IT. People are creating new applications and programs with the new attractive capabilities. But users sometimes don’t think about consequence. One of such questionable application is GetContact. What is GetContact?

Getcontact is a “Spam Blocking” and “Caller Identification” app for you. GetContact filters disturbing calls and allows only the people you prefer to communicate with you.

You can identify the calls you receive from numbers that are not registered in your Contacts

GetContact alerts instantly if you get an unwanted call. So that you get real-time protection from robocalls, telemarketers and scam calls.

Getcontact is also a social community. With Discover feature, GetContact App lets you connect people who you may know. A friend you have not seen for many years can send a request for communication, and if your friend approves your request, you can contact him again.

Surely it has its pluses and minuses.

Advantages:

• It uses the contacts of users for identifying a number. People will have the opportunity to know the name and image of every caller after installation the application.
• With the help of this app a person can also put some callers to a black list or block the unwanted calls.
• People can find out how their friends or relatives called them in their phone books.

Disadvantages:

• The application requires the access to person’s contacts.
• The user agreement allows the developers to share data with any third party.
• The knowing of person’s name in someone’s contact book can show him the opinion about him of others, and it’s not always positive. As a result, the person can deteriorate relationships with other people.

GetContact has already been banned in some countries. Nevertheless, the service keep being popular among millions people from over the world.

So, before installation of GetContact a person need to decide, are the capabilities of the app worth the risk of dissemination of data.

Yuliia Boiko
L.S. Koriashkina, research supervisor
I.I.Zuyenok, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Use of Information Technologies in Management of Enterprise

A modern industrial enterprise is a complex socioeconomic system for the management of which modern forms and methods of management are needed. Currently, one of the most important and vital problems for managers at any level is the use of information computer technology in the development of management decisions. The role of information technologies in management activities of the enterprise in modern conditions and possible IT contributions to quality of enterprise management systems is in the focus of this paper.

Information technology (IT) is a combination of means and methods of collecting, processing and transmitting data to obtain new quality information about the state of an object, process or phenomenon. The main goals of IT are the qualitative formation and use of the information product in accordance with the needs of the user.

Information technologies are the basis of the company's management activities. In accordance with various areas of management at the enterprise, the areas of IT application can be divided into:

- information technologies for input, processing and storing information on functional areas;
- information technology of information protection;
- information technologies of production processes management.

Information technologies for managing production processes include software tools and decision-making methods in various areas of the company's activities such as finance, production cycle, quality management, design etc.

A modern enterprise represents a subject which vital activity is provided by a whole complex of information technologies. As a result, modern information technologies are not so much a means of implementing auxiliary actions and providing services, but a means of providing the whole production complexes and processes.

Thus, one of the main advantages of modern technologies is the ability to quickly and optimally manage the enterprise. Today, IT provides the functioning of the whole production process and its elements, as well as a product obtained as a result of production. From my perspective, the introducing of information technology is becoming one of the tools to be used to improve the quality of the enterprise management system.

Ihor Bushmakin
M.L. Isakova, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

What if you never waited at another red light ever again? My vision of the future of the internet of things

The Internet of Things is a term that describes a world filled with sensors, actuators, robots, and computers that are all networked together and able to communicate with even larger networks.

The question is how the Internet of Things could affect our day-to-day lives in our own homes, like changing them from an elegant area of class to a swinging disco party with no effort whatsoever. However, it turns out the Internet of Things is much bigger than we think. According to HOSPA in 2013 there was one device connected to the internet per person on earth. They forecast that by 2020, this number will increase to 9 devices per person. The diagram on the Fig. 1 shows the potential growth of number of devices.

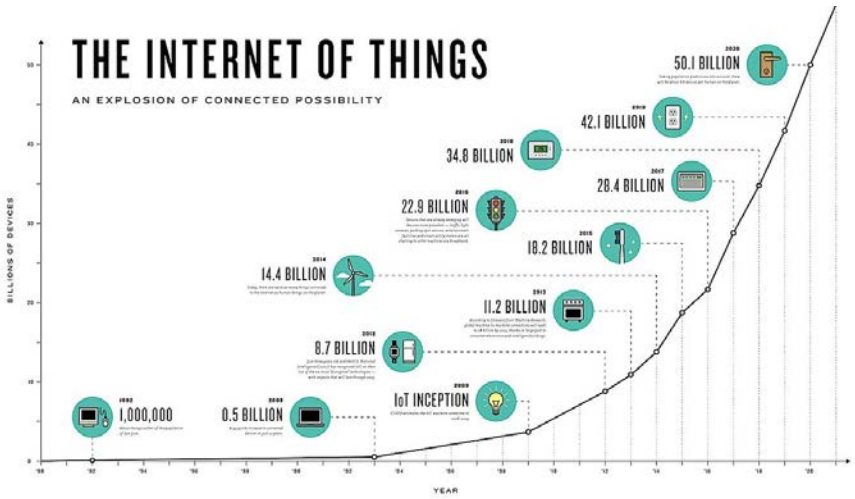


Figure 1 – The extension of the Internet of Things devices

We describe the potential of the world filled with devices that can detect changing conditions and react so quickly, it makes the blink of an eye look like an eternity. Imagine that you are driving down the street on your way to work, and you are using your car's navigation system to give you turn-by-turn directions to cut down on commute time. The car is communicating with sensors embedded in the environment, telling it the presence of other cars and bicyclists, even a pedestrian crossing the street two blocks ahead. The car is also in constant communication with the city's traffic system. All these sensors are working together to give you a smooth commute experience, cutting down on things that would frustrate you and funneling you through the best route, clearing your path of red lights and other delays.

The Internet of Things is going to enter industries like manufacturing and shipping, making them adaptable and responsive systems and increasing their efficiency, and with increased efficiency comes lower costs. The example of the

Internet of Things architecture is shown in Fig. 2. To achieve this, scientists, engineers, and researchers are going to have to overcome some big challenges.

Today, the good news is, most of these devices in the Internet of Things are communicating in very small amounts of data. But, when you have millions, or potentially even billions, of devices talking, it adds up quickly.

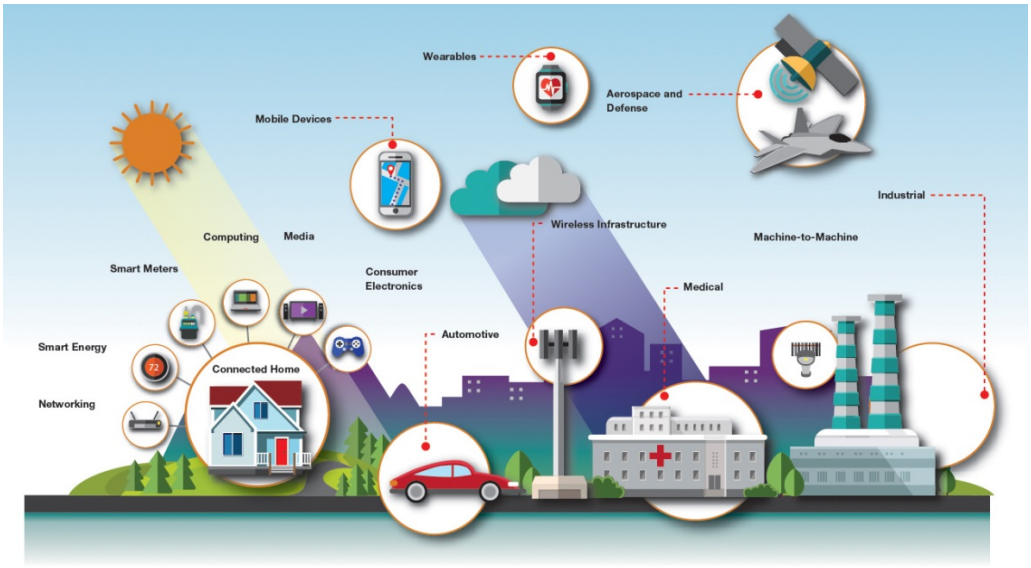


Figure 2 – The example of the Internet of Things architecture

Now, the components in the Internet of Things are still under development, like sensors which are expensive orother elements within the Internet of Things that are even more so. So, bringing costs down is one of the largest challenges we face today, which is likely surmountable. In fact, in 20-years' time, a lot of the things that frustrate us today will be a distant memory: traffic jams or forgetting to buy something.

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Anastasiya Chernokon
V.I. Mieshkov, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Cybersecurity in Business

2017 is called the year of birth of cybersecurity in Ukraine. Last year the number of cybercrimes was no longer susceptible to accurate calculations.

2018 is ready to face new challenges.

Cybercriminals are disabling industrial security systems. Of particular concern are critical infrastructure facilities such as oil and gas installations and nuclear power plants equipped with automated process control systems.

The interest in the crypto currency market is increasing. In addition to the thefts through intermediary resources (applications-purses, exchanges, smart contracts etc.), new types of fraud appear in this area. Android game developers or Internet providers mine crypto currency via personal devices, thus wearing them out and incapacitating them (for example, heating the phone / battery, damaging the smartphone).

The number of cyber attacks is expected to increase in the Internet of things (IoT), for example by obtaining remote access to a pacemaker or a self-driving car.

Small companies` owners mistakenly think that their business is not interesting for cybercriminals. Using outdated security software is a sufficient argument for hackers to choose such companies as a victim. In addition, a small organization can be selected as a back entrance to attack its partner company.

There are some rules to protect businesses. Firstly, not to rely on an antivirus.

It is not a secret that traditional antivirus solutions can not cope with most of today's threats. In 2014 Norton Antivirus Inc. loudly declared: "Antivirus is dead." Norton acknowledged that the traditional antivirus detected only 45% of all attacks.

Secondly, not to open the “door”. Most malware enters the system through exploits, programming errors or vulnerabilities. Thirdly, think about safety.

This requires huge investments in security. It is worth considering the cloud model. It enables organizations to quickly deploy security systems and manage them by the providers of cloud services, bypassing small pre-investment (or without them) and predictable monthly expenses.

Finally, pay special attention to mobile devices.

The most promising approach to mobile protection is the allocation of an isolated container inside the mobile device to work with corporate data and store it.

Many still believe that hackers are scary tales by which IT security experts scare their leadership. Businesses and the state are forced to pay close attention to issues of cybersecurity. In May 2018 the European Regulation on the Protection of Personal Data (GDPR) will come into force, non-compliance with which implies a fine of up to 20 million euros or up to 4% of the company's annual turnover.

Ilya Dontsov
I. M. Udovyk, research supervisor
I.I. Zuyenok, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Analysis of Docker Technology

Docker is a software containerization platform. Docker allows users to run different multiple software packages, including multiple instances of the same piece of software within an isolated virtual container. Their behaviour and features are similar to that of running a virtualized operating system such as allowing isolation from the host machine's operating system, the ability to run multiple instances of the same software package simultaneously and the storage of applications in a format that can be transferred between physical machines. Innovations and benefits of Docker use are in the focus of this paper.

Traditional virtualization hypervisors such Hyper-V, ESXi and Xen all rely on each virtualized instances to have their own complete operating system, drivers, libraries and software packages to be installed and running. Docker moves away from this method and instead provides an abstraction layer between the host operating system's kernel and the containerization application. The containerized applications are configured to share the same operating system and libraries. This removes the overhead of running multiple instances of these items reducing system resource utilization.

In addition to the performance benefits, Docker maintains the security features provided by virtualization hypervisors. Docker containers are configured to use virtualized network interfaces allowing segregation, VLAN tagging and inter-container networking amongst other features. The Docker container files are self-contained allowing them to be transferred freely between different physical hardware without the need for reconfiguration. This has also led to multiple repositories of Docker containers to be created, allowing the public to upload and share pre-configured open-source software packages.

The Docker security philosophy of “Secure by Default” spans across the concepts of secure platform, secure content and secure access to deliver a modern software supply chain for the enterprise that is fundamentally secure. Built on a secure foundation with support for every Linux isolation feature, Docker Datacenter delivers additional features like application scanning, signing, role based access control (RBAC) and secure cluster configurations for complete lifecycle security. Leading enterprises like ADP trust Docker Datacenter to help harden the containers that process paychecks, manage benefits and store the most sensitive data for millions of employees across thousands of employers.

By converting from using a traditional virtualized operating based configuration, end users can increase the utilization by running more software on less physical hardware. This in turn will reduce hardware, energy and other related costs and improve efficiency when deploying new software instances.

Web hosting services could increase the amount of services existing hardware could provide and increase efficiency when deploying new services. For example, each WordPress installation could be configured in individual containers while accessing a shared SQL database, rather than each installation requiring a full virtualized operating system to be deployed per instance.

Software developers can also take advantage of Docker to assist with their development and deployment cycles. Software can be configured and optimized on developer local machines or development servers and be easily transferred to quality assurance teams and finally to production environments.

Docker is an important step forward from traditional virtualization technology. The software has been developed under the open-source Apache License 2.0 allowing anyone to take part in development and to also freely use and modify any components for their own project both personal and commercial providing they follow the licensing requirements in their scenario.

By consolidating existing infrastructure energy emissions will be reduced, reducing the carbon footprint of users. Other consumables used in certain operations can also be reduced, such as water in server farm cooling configurations and physical space used allowing more compact configurations.

Management and maintenance of software packages can also be improved. If issues are found with particular software version updates, providing the previous container is kept the singular application can be rolled back rather than the entire operating system.

The analysis proves that Docker as a innovative software containerization platform can find its application for a wide range of processes for a set of the reasons described in this paper.

What began with 1146 lines of code has today turned into a billion-dollar product. Docker has grown to a stage where a majority of leading tech firms have been motivated into releasing additional support for deploying containers within their products. Examples include Amazon integrating Docker into the Elastic Beanstalk system, Google introducing Docker-enabled ‘managed virtual machines’, and announcements from IBM and Microsoft with regard to Kubernetes support for multi-container environments. Docker has already become a part of major Linux distributions such as Ubuntu, CentOS and Red Hat Enterprise Linux (RHEL), although the packaged versions often fail to keep up with the latest releases.

The Docker team has clearly laid out its goals of developing the core capabilities, cross-service management and messaging. It is likely that, in the future, there will be more focus on building and deploying rather than the level of virtualization, which is when the fine line between VMs and containers becomes fuzzy.

Oleksandr Dugenets
V.E. Kirichenko, research supervisor
V.O. Lapina, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Dubbed Banshee – a New DRAM Cache Design

At this stage in the development of computer technology, processors' transistor counts have gone up, the relatively slow connection between the processor and main memory has become the chief impediment to improving computers' performance. In the past few years, chip manufacturers have started putting dynamic random-access memory – or DRAM, the type of memory traditionally used for main memory – right on the chip package. The natural way to use that memory is as a high-capacity cache. DRAM is fundamentally different from the type of memory typically used for on-chip caches. The existing cache-management schemes don't use it efficiently.

At the International Symposium on Microarchitecture, researchers from companies such as MIT, Intel, and ETH Zurich presented a new cache-management scheme that improves the data rate of in-package DRAM caches by 33 to 50 percent. The bandwidth in this in-package DRAM can be five times higher than off-package DRAM. Putting the DRAM on the same package with a processor enables several times higher memory bandwidth than conventional off-package DRAM. Yet, the latency of in-package DRAM is not appreciably lower than that of off-package DRAM. A promising use of in-package DRAM is as a large cache. Unfortunately, most previous DRAM cache designs mainly optimize for hit latency and do not consider off-chip bandwidth efficiency as a first-class design constraint.

A new DRAM cache design, Banshee that optimizes for both in- and off-package DRAM bandwidth efficiency without degrading access latency. New system, dubbed Banshee, adds three bits of data to each entry in the table. One bit indicates whether the data at that virtual address can be found in the DRAM cache, and the other two indicate its location relative to any other data items with the same hash index. There is one problem with this approach that Banshee also has to address. If one of a chip's cores pulls a data item into the DRAM cache, the other cores will not know about it. Therefore, Banshee introduces another small circuit, called a tag buffer, where any given core can record the new location of a data item it caches. The buffer is small, only 5 kilobytes, so its addition would not use up too much valuable on-chip real estate. The key ideas are to eliminate the in-package DRAM bandwidth overheads due to costly tag accesses through virtual memory mechanism and to incorporate a bandwidth-aware frequency-based replacement policy that is biased to reduce unnecessary traffic to off-package DRAM.

The researchers' simulations show that the time required for one additional address lookup per memory access is trivial compared to the bandwidth savings Banshee affords and that Banshee provides significant performance improvement and traffic reduction over state-of-the-art latency-optimized DRAM cache designs.

Ilona Fursova
V.A. Sviatoshenko, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Intrusion Detection Systems for Computer Networks

An intrusion detection system (IDS or IPS) is a device or software application that monitors a network or systems for malicious activity or policy violations. Today, IDS and IPS are essential elements of network attack protection.

The protection provided by the firewall and the anti-virus is already ineffective against the network attacks of the malware. IDS / IPS solutions come out when detecting both known and unknown threats.

The IPS technology complements the IDS technology. IPS can independently identify the threat and successfully block it. The functionality of IPS is much broader than that of IDS. IPS blocks the attack (blocking access to resources, hosts, applications); modifies the protected environment (changing the configuration of network devices to prevent attacks), and changes the content of the attack (for example, removes an infected file from the message).

Intrusion prevention systems can be classified as follows:

1. Network-based intrusion prevention system (NIPS) monitors the entire network for suspicious traffic by analyzing protocol activity.
2. Wireless intrusion prevention system (WIPS) is intended for monitoring wireless activity and detection or prevention of attempts of internal and external network intrusions.
3. Network behaviour analysis (NBA) quickly detects problems on the network, which will speed up the time of their elimination and will determine the attack (Scan, DDoS, Internet worms, hacking).
4. Host-based intrusion prevention system (HIPS) collects information about the use of resources of a wide variety of devices, such as CPU.

The majority of intrusion prevention systems utilize one of three detection methods: signature-based, statistical anomaly-based, and stateful protocol analyses.

Signature-based detection is a method of operation of antiviruses and intrusion detection systems, in which the programme, when scanning a file or package, accesses a dictionary with known viruses compiled by the authors of the programme. Statistical anomaly-based detection is a technique for detecting abnormal states of network devices aimed at detecting improperly functioning devices on the network and the time intervals when the problem occurs.

Stateful protocol analysis is a method that identifies deviations of protocol states by comparing observed events with "pre-determined profiles of generally accepted definitions of benign activity".

In general, thanks to IDS, which is a software or hardware solution, the administrator can not only detect an intrusion or a network attack, but also predict possible future attacks and find vulnerabilities to prevent their intrusion.

Pavel Golenishchev
V. I. Mieshkov, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Artificial Intelligence - Our Hope Or Danger?

Artificial intelligence is much more effective substitute for humans when working with large data. The neural network as self-learning system is one way of implementing artificial intelligence. It operates not only in accordance with the requirements and formulas, but also on the basis of past experience.

A neural network simulates the work of the human nervous system, a feature of which is the ability to self-learn taking into account previous experience. Thus, every time the system makes fewer and fewer mistakes. Like our nervous system, the neural network consists of separate computational elements - neurons, located on several layers. The data arriving at the input of the neural network are processed sequentially on each layer of the network. In this case, each neuron has certain parameters that can vary depending on the results obtained. The neural network analyzes the signs (including lines, shapes, their size and colour) on the picture and builds such a recognizing model that minimizes the percentage of errors relative to the reference results.

Neural networks are still created by humans and might be able to solve a lot of complex technical problems much faster, but the concept of moral and ethics is far out of their reach. Artificial intelligence takes a big part in our daily life. Any knowledge of reality is a model in one way or another. Artificial intelligence is able not only to model the surrounding reality, but also interpret it to the certain extent. However, nowadays creativity remains the prerogative of humans. Supporters of machine art argue that if a machine is capable of creating a masterpiece that will be perceived by people as an art, then it is no longer important what way this effect is achieved.

Humans can not invent anything that would not be a combination of elements already existing in nature. Applicable to art, it is only half true. In art, everything depends not only on composition, but also context and interaction. The machine can create a piece of art coherent with all requirements, but it will not carry any idea. The machine can create a draft, but the final decision will remain for the human. Decision is the most important element of all creation.

Without man, creativity turns into the imitation of existing things. The image is individual and unique. You can not learn how to think creatively. Creativity is born with a human being. It concentrates the experience of all mankind, refracted through the individual experience of consciousness, through the personality and temperament of personality. If artificial intelligence acquired individuality, it could do art.

Oleksandr Golinko
M. O. Alekseyev, research supervisor
S. I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Automatic Diagnostics of Zero Readings of Means Monitoring the Methane Content

The complicated mining and geological conditions of coal deposits in Ukraine cause a lot of dangerous and harmful production factors, which lead to the high level of injury, occupational diseases and accidents in the industry. At coal mines in Ukraine, one of the main factors accounting for accidents with numerous severe consequences is gas and dust explosion, which is largely due to insufficient reliability of the control of explosive atmospheric conditions in mines and underestimation of the danger of explosions.

Nowadays, in the existing gas analyzers, the thermocatalytic method of control is used mainly to determine the content of methane in the atmosphere of mine workings. The conducted research of the method and the thermocatalytic means of methane control have significantly increased reliability and stability of such gas analyzers [1, 2]. However, when gas analyzers are used under severe operating conditions (accidental strokes, water pouring, extreme values of factors etc.) and when there is an unauthorized interference with the work of analyzers, their performance and stability can be affected. This, in turn, can lead to the failure of explosion protection means being one of the reasons for accidents in mines. An example of this is the recent accident with numerous fatal consequences caused by the explosion of the methane-air mixture that occurred on March 2, 2017, at the Lvivvugillya Steppe mine where despite the availability of rather expensive system of automatic protection explosion protection devices did not switch off the equipment when the methane concentration was highly explosive and became one of the reasons for explosion.

In order to increase the reliability of stationary thermocatalytic gas analyzers factors influencing the reliability of methane analyzers have been investigated in our laboratory and in mine conditions, the causes of failure and unstable work have been identified and explained, as well as the peculiarities of the analyzers' work have been studied when the flow of methane air mixture to sensitive elements is restricted due to the filling of primary converters with water or significant pollution of gas diffusion filters in thermocatalytic sensors.

The methods of automatic diagnostics of methane control means are theoretically and experimentally substantiated including the diagnostics of zero measuring bridge of thermocatalytic gas analyzers by reducing the power supply voltage of the sensor to the value at which there is no methane oxidation reaction on the catalytically active element, when using the proposed scheme for the inclusion of the thermocatalytic sensor in the measuring bridge, which allows to stabilize the temperature mode of thermoelement operation.

Today, the control of thermocatalytic gas analyzers' zero readings is carried out by the introduction of clean atmospheric air sensors. Performing such an audit in automatic mode is difficult and inappropriate. The essence of the method proposed for the diagnosis of zero is the short-term transfer of the thermogroup of the gas analyzer to such a mode of operation, when no oxidation of methane occurs on the working element. Attempts to implement such a method of diagnosis were made in the eighties of the last century, but given the relatively low level of electronics development, the lack of effective means of preserving information and microprocessor information processing tools they were all a failure.

Diagnosis can be done either automatically, on the internal timer command, or on an external request, for example, a request from the maintenance service crew on the surface. The widespread introduction of modern microprocessor information processing equipment from the primary converters makes it the most promising for carrying out diagnostics of the gas analyzers performance in the automatic mode.

In the future, to automatically control the sensitivity of gas analyzers, we will carry out research on the work of thermocatalytic sensors at different modes of supply of controlled methane air mixture to sensitive elements and transient processes in sensors when changing their supply mode.

Conducting such studies will allow:

- to identify cases of unauthorized interference with the operation of security systems that are carried out by forced zero displacement of the gas analyzer;
- to identify cases of unauthorized restriction of the flow of methane air mixture to a remote sensor and cases of change in sensitivity of gas analyzers in case of accidental contamination or flooding of the metal-ceramic sensor filter;
- to reduce the cost of maintenance of air-gas control systems at mining enterprises.

The following are some of the findings emerged from the study: we have proposed circuit solutions and developed algorithms for analyzers that allow automatic diagnostics of their condition and thus prevent the occurrence of explosions in case of emergency situations connected with gasification in mine workings. This will ensure a significant increase in the safety level of coal extraction in gas mines.

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Nikita Harzha
V.A. Svytoshenko, research supervisor
I.A. Ivanchenko, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Drone and autopilot technologies

A drone, in a technological terminology, is a kind of an aircraft that could be controlled remotely. These machines are commonly known as unmanned aerial vehicles (UAVs) or unmanned aircraft systems (UASes). They can also use fly through software-controlled flight planes. Few years ago UAVs were considered by people only as military technologies. But nowadays drones are used in different spheres of civilian life.

Robots, drones have become really popular these days. Drones have already been involved into traditional industries which were the most impenetrable for innovative technologies. The drones that are controlled by a remote or with the help of smartphone app could reach the most distant areas almost without spending much power and this requires the least amount of our effort, time, and energy. The first drone, actually, wasn't a 100% drone, because it was constructed on the base of the de Havilland DH82B Queen Bee biplane, and this drone was fitted out with a radio and service-operated controls in the back seat. However, nowadays all the technologies in our world have different issues and problems with realization. The rules and regulations connected with drone technologies have started to develop recently, but safety could become a critical issue for this kind of technologies. There is also a number of problems connected with realization of drones commercially. Mostly, the difficulties depend on the laws that function in the leading countries of our world, such as the USA and UK. One more problem lies in software development. Although drones became popular, companies producing drones can't guarantee safety of the drones. And the last problem is one with human health that could be caused by the work at Drone control station. This technology requires installation of additional monitors. The lack of space in the trailers means that these monitors should be installed vertically.

The easiest solution is the one with laws and it could be solved by the government of the countries by changing these laws for the better (make operations with drones legal). Problems with software could be handled only by the upgrading this software and making attack the drones almost impossible. Laws should also protect drones from being hacked by introducing a bigger liability for this kind of crime ,thus making hacking more complicated from psychological side. And the last one could be solved by making life of pilots easier. Give them more free space in their work and not to give them so much information to analyze. In conclusion we can see that drone technology has its pros and cons, but if humanity solves all the problems with this technology, then we couldn't even imagine the advantage that it will give in different spheres of our life.

Anastasia Horelova
L. S. Koriashkina, research supervisor
I. I. Zuyenok, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

System analysis for sports and healthy lifestyles

Till recently, people were firmly confirmed that solving complicated problems 'by piecemeal' was a path leading to success. Such an approach allows to divide one big problem into small sub-problems and having found a solution for each of them separately combine these results all together and get a general first-needed resolution. However, despite intuitive rightness and consistency of the method, it did not bring expected benefit in most cases. The problem is that solving problems part by part usually misses a very important factor – links between the compartments. This neglecting often led to the situations, where systems assembled from parts independently are working well, but do not perform in a correct way. Having faced with this repeating failure, experts of Economics, Mathematics, Psychology and Business started to recognize the value of internal links and to involve them into the process of solving problems. They joined their efforts and came up with a new *System Approach* that not only considers connections within a system but emphasizes these very connections to be the most important part of any problem.

System Analysis as a methodology of System Approach offers a kind of tool kit can be applied to any possible problematic field, though with some adjustments. One of the founders of modern marketing W. E. Deming points out that understanding of system's connections and ability to model system's organization as the one whole is crucial for those managers who strives to succeed in any field of performance.

As soon as health is the most important aspect of our life and every human being is a manager of his health, applying system approach to maintaining fit lifestyle seems to be preferable and resultative. To live a healthy lifestyle, we need to consider health as a complicated system consisting of many different compartments such as doing sports, healthy meals, nutrition, proper daily schedule, maintaining work-life balance etc.

The very first step in forming this 'system' it is necessary to gain deep theoretical knowledge and previous practical experiences from all the mentioned fields, so that to define a spectrum of factors that will take part in the lifestyle changing act. A major principle is to consider personal features and qualities that can affect the life process: some diseases, physical disorders, working/studying schedule and others. Such system's properties as *flexibility* and *adaptability* are reflected in this principle. It means that there is no universal approach which would work for every human. This stage can be called **investigation**.

Once a clear picture of everything involved the process is drawn, the next stage is **planning**. During this stage step-by-step algorithms are being designed, their feasibility is being estimated, and some amendments are being made if necessary. **Planning** is very important because it shows how the system presumably works and

what actions should be done to force it to work this way. On this stage system's complexity is manifested.

At the **testing** stage the designed algorithms are being performed and checked. The two most important properties of system: *integrity and emergence* are examined by 'trying and failings'. These properties reveal the fact that features of the system in whole do not equal to features of its parts, because while combining and interacting new behavioral changes appear.

The final stage is **maintaining** system in a sustainable condition. Depending on changeable outer conditions that affect the system and try to break its performance, correspondent measures should be taken to return the system to stability. At this point *sustainability* of the system provides its *reliability* and *survivability*.

The process of making lifestyle healthier implies using different helping devices which can accelerate some changes and control the general workflow. For example, fitness trackers and bracelets offer a wide spectrum of functionality – from improving sleep to designing effective trainings – to simplify living healthy life as much as possible.

For example, a 'fitness bracelet' as a wrist device made in the form of a bracelet or a small block on a strap is designed for permanent wearing on the wrist. Alternatively, this unit can be worn on the neck as a pendant or be fixed by a special clip on clothes that make it appropriate to use by disabled people too. It performs many different functions: monitoring pulse and blood pressure as well as calculating the number of calories burned etc. It is not only your own 'fitness trainer', but a Mp3 player and a 'pager', notifying calls and messages that have arrived on your smartphone. It has a built-in pedometer which provides reliable information on how many steps are taken during a day, when you need to have a walk after long sitting etc. The second basic function of modern fitness bracelets is tracking a sleep. Built-in fitness bracelet sensors can automatically recognize the periods of sleep, the phase of deep sleep and the time at which your body can most easily wake up.

Numerous programs are performed to support people's desire of healthy lifestyle at government level. For instance, in Ukraine, "Healthy Lifestyle" was established to help those wishing to lead an active lifestyle, find their direction and a qualified trainer.

An impact of all these external catalysts demonstrates such system's property as *functionality* which implies changing of system's behavior when interacting with outer environment.

So, since System Approach proved its efficiency in so many fields of human life, it can be applied to organizing one's own healthy lifestyle as well. Considering health as a complicated system allows to use verified tool kit to manage it, and competent using of techniques and principles of System Approach can bring long-time effects in improving quality of a human life.

Maria Hrytsenko
O. V. Kruchynin, research supervisor
S. I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Tricky Meltdown And Spectre Attacks

Meltdown and Spectre attacks have recently appeared in all possible Intel or AMD processors. They are the worst in IT industry. These attacks are using critical vulnerabilities in all possible processors. The problem is in their chips. These hardware vulnerabilities allow different programmes to steal data, which are processed on the computer at the certain moment.

While programmes are not allowed to read data from other programmes, a malware program uses Meltdown and Spectre to get the secrets that are stored in the memory of the pristine running programmes. This might include passwords, personal photos, emails, instant messages, business - critical documents. Meltdown and Spectre can work on mobile devices, personal computers, and in the cloud.

Meltdown violates one convention on which all developers and software administrators rely, that is the central processor. It completely isolates the programmes running on it. This principle is the foundation of all information security.

It is considered to be impossible to use this vulnerability on AMD processors. In theory, it may be, but not in practice. AMD's processors are protected better than Intel's counterparts, but this is not certain: later someone can find Meltdown on them. It is dangerous to work with confidential information, when one computer has a vulnerable processor and runs an unpatched operating system. Spectre is much harder to exploit than Meltdown, but it is also harder to soften.

This vulnerability can select access to programmes. The access keys, which are built into these programmes, make the applications defenseless. The drawback is in the structure of the chip, and it can be corrected only by redesigning the hardware.
The exploitation of these two vulnerabilities does not leave a trace in the log. That is why it is impossible to detect them.

Meltdown and Spectre are hard to distinguish from usual applications, unlike usual malware. However, antivirus may detect malware, which uses the attacks by comparing binaries after they become known.

It is unclear how serious the Meltdown and Specter vulnerabilities will be. As the root of Meltdown and Specter is at the hardware level, ideally this equipment should be replaced.

The microcode's combination of the processor and the update of the operating system can mitigate the hit of these attacks.

Ekaterina Ihnatova
V.A. Sviatoshenko, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Social Engineering

Social engineering is the method for obtaining information for further use in hacking passwords. It is based on human psychology.

In the information security sphere, the term social engineering was popularized at the beginning of the 21st century by a former computer criminal, now a security consultant Kevin Mitnick who claimed that the most vulnerable place of any security system is the human factor.

Although the term social engineering appeared not so long ago, the method of obtaining information in this way has been used for quite some time. Those who want to get some state secrets or get information may use social engineering methods.

There are different types of social engineering: pre-texting, phishing, Trojan horse, road apple, qui about quo.

Pre-texting as an action worked out according to a pre-compiled scenario may involve a lie and require preliminary research.

Phishing as a method designed to fraudulently usually obtain confidential information. Typically, an attacker sends an e-mail target, forged by an official letter demanding "verification" of certain information or performing certain actions. The Trojan horse, a malicious programme that an attacker distributes by using e-mail, remains effective, while the "victim" pursues curiosity blindly clicking on the attached files.

Road apple, a method of adaptation of the Trojan horse, uses physical carriers. An attacker can toss bootable flash drives or disks forged under media with interesting or unique content.

Qui pro quo introduces malicious software into the systems of various companies. Not to become a victim of social engineers, it is worth following the following protection rules: not to use the same password to access external and corporate resources; not to open letters received from untrusted sources; to lock the computer when not in the workplace; to install the antivirus; to read the privacy policy of the company; to discuss only the necessary information by phone and in a personal conversation; to delete all confidential documents from portable devices. All employees should be instructed on how to behave with visitors and what to do when illegal intrusion is detected.

To conclude, every user of the system should be aware of the danger of disclosing confidential information and know the ways that can help prevent leakage.

Yelyzaveta Ivanchenko
G. M. Saksonov, scientific supervisor
I.I Zuyenok, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

NFC Technology: What? What for? Why and where?

Initially, Near Field Communication (NFC) technology received the maximum distribution as a technology for making contactless payment. However, this technology is increasingly being used in various gadjets such as smartphones and tablets. Almost all major manufacturers have begun to equip their mid-to-high-end models with NFC adapters, So, from recently, anyone could use a smart-card with a built-in NFC chip as a public transport card, like a payment card in retail establishments, as an “intelligent” business card or as a contactless key-card.. The essence of NFC and the reasons of its popularity are examined in this paper.

A wide range of modern platforms use NFC. If to describe briefly the principle of how it works, NFC is a technology that is used to allow two electronic devices communicate with one another at a close distance. The main areas of using NFC application:

1. NFC as a means of paying;
2. Quick transfer of files from one smartphone to another one;
3. Wide range of application. Use of NFC modules nowadays is not limited to smartphones, only as it could be used in digital cameras and tablets, making data exchange easier.

Ultimately, using NFC can simplify people’s life, but there is the main concern of its uses -t safety of NFC, especially in the cases, when NFC is used to make payments through a stored credit card. So, NFC is mostly used for payments. I

It has lots of advantages. Mobile terminals can write off money from the card without the introduction of a pin-code at a distance of 10 sm. However, there is a risk of stealing one’s money. Being aware of this drawback, NFC developers have limited the amount of written off money from the account to extremely small amounts in order to avoid the risk of large losses.

NFC can be built-in any of the modern gadgets such as iPhone (from models iPhone 6 and iPhone 6 plus), Google Pixel (all models), Samsung (Samsung S7, Samsung S7 Edge, Samsung 8 Note) etc. Also there is a smart nail. And as it said, digital cameras and tablets.

To sum up, nowadays NFC technology is gaining its popularity by taking place in the majority of the modern high-end mid-range smartphones and other gadgets despite of the risk of losses of small amount of money. By examining these risks, programmers have been developing updated programs and design new ones, especially for Android platform being dominated now that leads to widening areas and devices of NFC application.

Ilya Ivanyk
V.V. Tkachev, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Automation of production

Technology has changed the nature of production over the past few years. In process in the development of mechanized production in which the control and monitoring functions previously performed by humans are transferred to instruments and automatic devices. Now that computers and technology have penetrated the industry, automation has become the competitive advantage in today's manufacturing world.

The aim of automation is to improve the efficiency of labor and the quality of manufactured products and to create conditions for the optimum utilization of all production resources. Automation of production is one of the basic factors in the modern scientific and technical revolution which is opening up unprecedented opportunities for mankind to transform nature, to create enormous material wealth, and to multiply the creative capabilities of humanity.

However, these opportunities are not fully used. There are many problems that are relevant at the present time and can be solved with the help of automation tools. Some of these problems are given below.

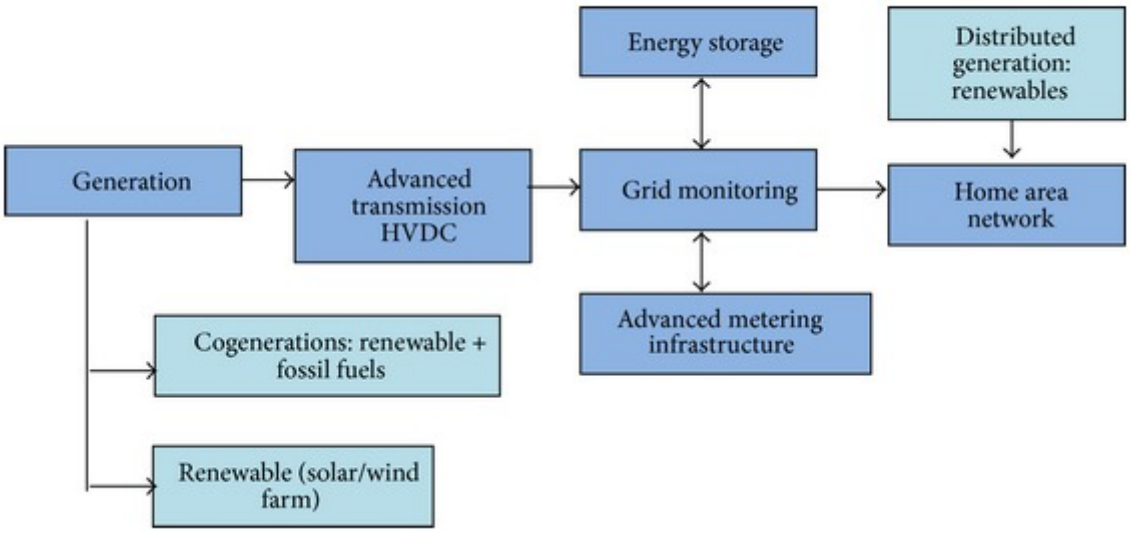
- Global population growth and improvement of living standards cause high energy demand. This global energy demand is increasing faster than the population growth rate.
- In many companies each department has its own software system that does not mesh with the software used by the other departments, this is leading to problems, that impede information flow and analysis, employee productivity, and sales growth.
- At any stage of the supply chain, there are many factors that might lead to unpredictable circumstances that can set back production schedules.

To address the above-mentioned problems and many other similar problems are used special systems that collect information, process it and perform actions sought at solving the problems encountered.

Such systems include the Enterprise Resource Planning Systems. The purpose of ERP is linking together the software of each department into a seamlessly integrated system that equips team to more easily and efficiently capture, manage, and share business critical information across all business units. However, from the statements of Thomas Weigum, the author of the article "The Guide to Enterprise Resource Planning Systems," it follows that if you use ERP to improve how orders are taken and how goods are manufactured, shipped and billed for, you will see value from the software. If you simply install the software without changing how departments operate, you may not see any value at all.

Also, one of these systems is a smart grid, the purpose of which is to enhance overall management, which refers to obtaining better control of the transmission system that will improve system reliability. The author of the article "Global Renewable Energy-Based Electricity Generation and Smart Grid System for Energy Security» M. Hasanuzzaman claims that the objectives of smart grid are to ensure the availability of the power supply based on customer requirement, the two-way communication system, and the data security of the customer. This concept is shown in the block diagram below.

Figure 1 – Block diagram of the smart grid concept



Also to these systems should be attributed the Internet of Things. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. Moreover, smart industrial IoT management systems can also be integrated with the Smart Grid, thereby enabling real-time energy optimization

All of the above objectives that arising in the process of building an information system, and methods for solving them, are the most common. Naturally, each enterprise has its own unique organizational specifics, and during the implementation different nuances can arise that require additional consideration and search for methods for their solution.

In my opinion, the use of these information systems in production can yield substantial opportunities for the futures, if used wisely and effectively. There is an opportunity to relieve humans from repetitive, hazardous, and unpleasant labour in all forms. And there is an opportunity for future automation technologies to provide a growing social and economic environment in which humans can enjoy a higher standard of living and a better way of life.

Kostiantyn Khabarlak
L.S. Koriashkina, research supervisor
N.M. Nechai, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

On deep neural network activation function selection

The field of deep machine learning has become an active area of research over the past years and the results are astonishing: models based on deep learning are getting highest scores across the board, beating humans in some of them.

Building and training a neural network is a complex research task with many hyperparameters. One of the most important ones is that of neuron's activation function selection as optimization's speed and quality is highly dependent on its choice. Given that there are a lot of different activation functions, it is hard for a beginner researcher to understand which is the best one to pick for a given task.

The goal of this research paper is to investigate how accuracy of an image recognition depends on a selection of an activation function of a neural network and its parameters. Determining the most effective activation functions based on their advantages and disadvantages will make it possible for the researches to quickly build and train neural networks of different structures and for the analysts to get representative and accurate data models.

Neural networks consist of stacked layers of trivial neuron-like elements, the so called artificial neurons. It has been proved theoretically that a single-layer network can approximate any function with an arbitrary precision, given that the number of neurons is not limited. Consequently, neural networks are considered to be a universal approximator [1]. However, in the real world it is not possible to have an infinite number of neurons, training several millions of them presents a serious challenge to modern PCs. As a solution to this problem, deep convolutional networks were proposed which, by stacking multiple layers of neurons and reducing their number in each individual layer, can estimate much more complex functions while keeping neuron count low.

Deep neural networks were built with an underlying idea of mimicking human's brain activity, as a result, unlike computer algorithms, which help solving well formalized numerical problems quickly and efficiently, deep neural networks target a problem of understanding surrounding world, which is done unconsciously by human beings and other animals.

The following activation functions have become the most widely used: sigmoid, hyperbolic tangent, rectified linear unit (ReLU), leaky rectified linear unit (leaky-ReLU) [2].

Sigmoid function $y = \frac{1}{1+e^{-x}}$ has an easy interpretation of a neuron's activation and can be differentiated infinite number of times. When building simple neural networks, it is being used in the first place. However, sigmoid functions tend to oversaturate and cause a problem of vanishing gradient (when gradient becomes so small that network is barely able to train). Moreover, sigmoid output lies in range of

$[0; 1]$, which is inconvenient in some cases. Hyperbolic tangent function $y = \tanh x$ preserves all the advantages of a sigmoid function but has an output $[-1,1]$. ReLU $y = \max(0, x)$ solves most of problems of the previous two activation functions. In practice switching to it gives 6x boost to the training speed. Withal they have a serious problem of "dead neurons", when neuron activation drops to zero which consequently makes its derivative always equal to zero. To mitigate this problem, it was proposed to use leaky-ReLU instead: $y = [x < 0] \cdot \alpha x + [x \geq 0] \cdot x$, where α is a small constant.

A five-layer-deep convolutional neural network has been built to determine which of the activation functions provides better results in practice. MNIST handwritten digits have been chosen as a target dataset [3], which is considered to be simple and fast to train neural networks on. Sigmoid and hyperbolic tangent functions have shown slow convergence with spontaneous quality drops, after 5,000 iterations they have scored 98,86% and 99,19% respectively. ReLU and leaky-ReLU have much more stable convergence and higher accuracy scores, 99,43% and 99,44% respectively, which makes ReLUs a default choice for deep neural networks.

More and more data scientists are being attracted by growing neural network effectiveness. However, it is hard to master a large number of hyperparameters. The crucial one is an activation function. Four most commonly used and most effective activation functions were discussed in this paper, key advantages and disadvantages were described, which will allow building productive models much easier and faster.

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Andrii Kiselev
A. A. Martynenko, research supervisor
V. V. Zabolotnikova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

GameDev in Ukraine. Can we?

A "game dev" is short for "game developer", which is a company (also called a game studio) or an individual who makes video games. When referring to an individual who makes video games, the term "game developer" often is synonymous with "game programmer" (while programmer is synonymous with "coder" or "engineer"), but it can also refer to anyone working on a video game development team: designer, artist, producer, and so on.

The effort is undertaken by a game developer, who may range from a single person to an international team dispersed across the globe. Traditional commercial PC and console games are normally funded by a publisher, and can take several years to reach completion. Indie games can take less time and can be produced at a lower cost by individuals and smaller developers. The independent game industry has seen a substantial rise in recent years with the growth of new online distribution systems, such as Steam and Uplay, as well as the mobile game market, such as for Android and iOS devices.

11 years ago Western world met polish “Witcher” made by Cd Project Red. It was a great success. Poland became a big part of Game industry. Now we have such great polish games like “Dying Light”, “Vanishing of Ethan Carter”, “Bulletstorm”, “Observer” and “Witcher 3”.

11 years ago Ukrainian company GSC Gameworld released “S.T.A.L.K.E.R. Shadow of Chernobyl”. And it was a great success too. But Ukraine didn’t became a big part of Game industry. Now we have only AAA (triple-A) “Metro 2033” made by 4A Games. Why?

The problem of gamedev in Ukraine is isolation. While Western world developers are able to change job in one country for better work in another, in Ukraine this opportunity is closed to them. In theory foreign developers could work in ukrainian companies. But on practise they can’t adopt to life in Ukraine. And until this very important factor isn’t eliminated ukrainian games won’t have a great success.

Sadly, but the only way out for now is to expand the companies to the west. Like 4A games. They founded company in Kiev but 3 years ago they opened office on Malta. Now half of company is west oriented. “Ukrainian” part is still work on great games, but using experience exchange with western developers.

Maybe somehow such active cooperation will provide our people to the new way of thinking, which will be foundation for higher life standard in our country.

Iryna Kolmaz
V.O. Tkachov, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Introduction of the Internet of things in our lives

Nowadays it is not surprising that technologies have been firmly integrated into our lives. Automation is an important part of the development of modern technologies. We want our devices to be controlled from anywhere in the world and to understand when and how to operate them. But technology requires constant improvements, as well as the Internet of things (IoT).

There is a problem with the compatibility of IoT devices with wireless standards. Multiprotocol / multiband systems are useful in many embodiments. It is the easiest use to explain and implement. However, developers should closely review the hardware interaction of the device (System-on-chip (SoC) or module) with radio schedules and stacks to create working applications. Now developers have access to many energy-efficient and reliable options, such as Zigbee, Thread and Bluetooth low energy (BLE). Tom Pannell from Silicon Labs claims that only SoC developers who make all products not automatically, but manually, make SoC sufficiently integrated, and the software optimized. An even smaller number of developers are offering tools to work with Multiprotocol systems. In addition to Multiprotocol connectivity issues, there are some security issues. It is very important to develop a technology that will provide secure communication between the sensor and the server. Furthermore it is important to protect your IoT device with a microcontroller that provides secure device booting and communication with server. An example of such controllers is the cryptographic controller, the MAXQ1061by Maxim's DeepCover portfolio. A turnkey pre-programmed secure microcontroller, the MAXQ1061 offers secure key storage, digital signature, and encryption services.

Moreover, the introduction of the IoT gave fillip to the new platform - the on Semiconductor IoT Development Kit (IDK). Both software developers and engineers worked on this platform. The modularity of IDK opens opportunities for its wide interaction with sensors and other hardware. Such systems will play a key role in the implementation of the IoT.

An interesting example of using IoT can be seen in Arizona State University. It has launched a pilot project to see if using IoT could help advisors reach out to students. To understand the level of attendance of a course, the University offers students the opportunity to follow them with a smartphone. The data do not go to the teacher, but the University knows who came into the class and who did not.

Considering all the above-mentioned facts, it should be noted that Internet of things already has a lot of practical applications, but needs constant revision, like any other technology. Such technologies as IoT are the future, so we must pay more attention to them to avoid serious errors and vulnerabilities in the development.

Anton Korniievskyi
V.I. Mieshkov, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Cyber Threat Predictions for 2018

Fortinet specialists have analyzed the potential cyber threats and strategies that attackers can use in 2018. Soon, both the total number of attacks and the variety of their directions will grow. The loud global cyber-attacks of 2017 caused enormous material and reputation damage to companies around the world. Many managers realized for the first time that they could lose business if they did not take measures to protect information. According to Fortinet, in the next few years the number of vectors of attacks will continue to grow. The spread of the Internet of things opens opportunities for intruders to access different objects from several IoT devices, cars, houses and offices to "smart" cities. Hackers use achievements in the field of artificial intelligence (AI) development for effective attacks.

In the future, hackers will replace botnets by intelligent clusters of affected devices, so-called "swarm" networks. Gradually the ability of bots to self-study will increase. This makes a very complex prediction of large-scale attacks and will increase their destructive power.Currently, about 3 billion attempts are made quarterly to establish a connection between botnets, and hence the creation of destructive "swarms" is only a matter of time. The number of attacks using extortion software over the past year has increased by 35 times. The next goal is to provide cloud services, which can lead to disruption of the activities of hundreds of organizations. According to Fortinet, in the coming years "crime as a service" will actively develop. There have already been recorded cases of selling modern tools developed based on machine learning technologies. In the future, this will make it more difficult for cybercriminals to discover the means of penetration.

Thus, the emergence of new technologies in the field of AI and automation opens new opportunities for cybercriminals to attack. Integrated technologies, relevant data on threats and dynamically configurable adaptive network security systems should be at the heart of cyber defense tools.

Cyber security should not be inferior in speed to the speeds of digital connections. This means the need to introduce automation, self-training, online detection of affected network nodes: from endpoints and local network resources to the cloud. In addition, basic measures of cyber defense should be included in the main security protocols. This requirement is not always considered, but it is its performance that is the key factor in preventing negative consequences.

Anton Kravetskiy, Rodion Nedaykhleb
A. Martynenko, research supervisor
I. A. Ivanchenko, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Full Immersion in Virtual Reality

What is a full immersion? This is when the difference between the virtual and the real world is not felt. That is, you do not feel in which of the worlds you are.

First, we consider the components of a complete immersion. There are only six of them.

The first and most important point is a visual picture. Everyone is accustomed to immersing himself in virtual reality with the helmets of virtual reality. As a rule, they are HTC Vive, Oculus Rift, Gear VR, PS VR and other helmets, which are available on the market now.

The second important point is sound. Without sound, you can't be immersed into a virtual reality immediately. The picture must be completely combined with the sound. It is necessary for the user in virtual reality to position himself in space and know where he is.

The third, even more important point is the tactile connection or haptic. In western terminology, it is called haptic feedback or "reverse tactile communication".

As for the other components concerned (simulation of taste, simulation of smell, the position of man in space), unfortunately, the virtual reality at this stage of development is real only to some extent.

There are a number of problems, without solving which, one can only dream of a full immersion. The first and most basic one is that now for immersion into virtual reality, only 2 feelings out of 5 are stimulated, namely sight and hearing.

The second problem is the presence of wires in the PC and console helmets. A large amount of data is passed through the virtual reality helmet, and for this, wires are needed. In order to feel completely free in virtual reality, you need to remove them.

Another problem is the interaction with the virtual world. As a rule, in order to fully interact with it, you need controllers. Now in the role of controllers are those ones from such manufacturers as Vive, Oculus Touch, etc. But in order to fully interact with objects, to be able to touch them, rotate, take, feel its texture, weight, we need virtual reality gloves in which you need to build in complex mechanisms to perform all these actions.

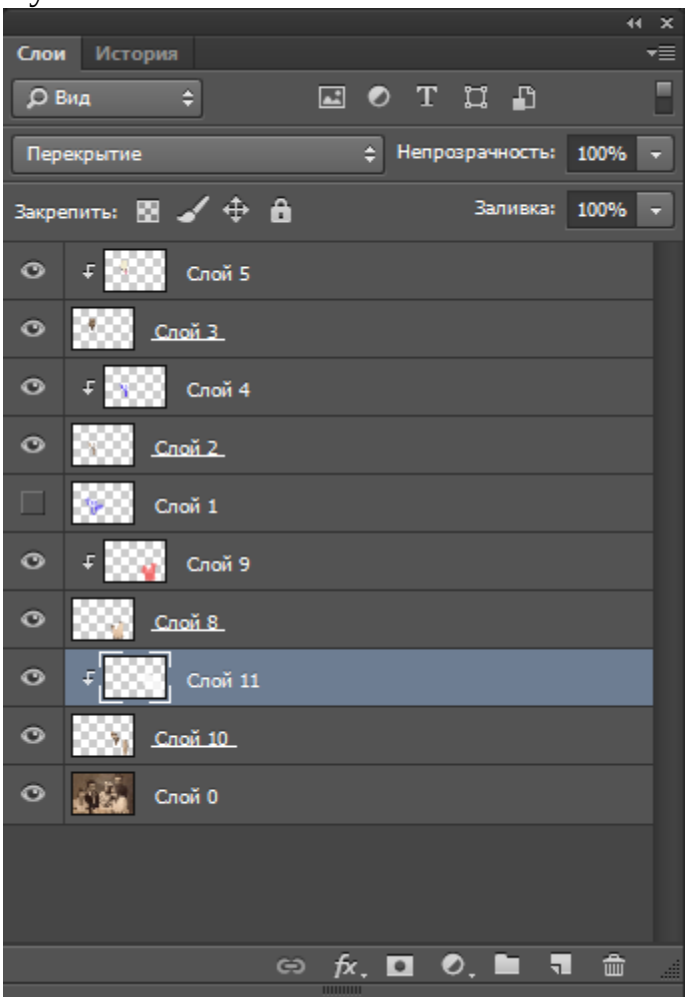
The systems that will allow the computer to be connected directly to the human brain have been developing for a long time. Currently, the most discussed as well as a very complex project is Neuralink from Elon Mask. Taking into account the present-day level of information technology, this work will not be finished earlier than in 15-25 years, and possibly more. But as soon as the neural interface is created, humanity can have an opportunity of a complete immersion in virtual reality.

Anatolyi Kryvytskii
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Image Processing Tools

Nowadays, modern software offers a range of tools to process images, Adobe Photoshop is one of them. This is a program for changing photos, drawing pictures and special symbols.

At present, we have opportunity to work on different platforms like an **Adobe Photoshop(Ps), 3Dmax, Unity** and etc. The aim of this paper is to describe tools offered by Ps. When we open a photo or some picture in Ps, we can see some layers in a dialogue window. Every your picture and special tools will be displayed on this layers.



The program is very convenient in use, because in history you can see all of your actions, and you can come back or delete every your action.

Along with other useful functions, Photoshop can be used to restore old photos with special tools, like «**stamp**», «**restoration brush**».

Stamp is the process of removing unwanted objects, which consist in the fact that we will clone the pixels from the nearest parts of the image and build them into new places (where the undesirable object is located).

The tool works like this: go to the clean area (which will then be located on the site of the object), hold down the Alt key and click on this place. This means that you have cloned the area. Move to the object and click on it.

And the "Recover Brush" tool allows you to correct image defects based on adjacent areas. Like with the cloning tools, the "Restore Brush" drawing is done using pixels selected from an image or pattern. However, the "Restore Brush" tool also matches the texture, illumination, transparency, and shadowiness of the sample pixels with the same pixel parameters of the restored image. As a result, the restored pixels seamlessly blend with the image.

Thanks to these tools we can get of this result. If we take some other tools, we can colorize black and white photo.

Before

After

Maria Krokovna
I.G.Hulina, research supervisor
V. V. Hubkina, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Cloud Technologies

Modern development of the world market is accompanied with a wide use of information systems where cloud technologies are starting to take a special place. They are gradually becoming one of the most important factors that influence the increase in the competitiveness of companies in a wide range of industries and spheres of activity.

Generally, the novelty of researching the directions of using cloud technologies consists in expanding the model of Internet hosting beyond the boundaries of the lease of Internet sites and the possibility to cover the broadest range of tasks that are solved by traditional information technologies.

In fact, cloud technologies are software and hardware accessible to a user through a local network or the Internet, for the purpose of remote access to certain resources, including, first of all, computing power, data storage and software. There are three models of service to be provided with the help of the cloud: SaaS, PaaS, and IaaS. The greatest preference in the Ukrainian market of cloud technologies is given to such services as IaaS and SaaS.

The increasing demand for cloud services can be explained by the advantages they provide. The availability of these services at any point where the Internet connection can be obtained is considered to be the most important feature. Consequently, this allows companies to use cloud technologies to achieve significant savings on high-performance computers and expensive software.

One of the most important advantages of cloud technology is possibility to get access to unlimited resources provided by the use of so-called virtualization systems. A further advantage is the reliability of cloud services, achieved by basing their hardware and software core in specially equipped data centers (data centers), having security, professional maintenance personnel, backup power sources etc.

But is should be noted that despite a great number of advantages, the use of cloud technologies is accompanied by a number of problems.

Firstly, lack of access to the Internet is the main disadvantage of "cloud technologies", because if you need to access files or applications, you need to establish an Internet connection with the service.

Secondly, in the event of violation in the data backup system, the company is exposed to risk to completely losing information located in the "cloud".

Thirdly, despite the reliability of cloud data warehouses, there is always the possibility of hacking them from various intruders who, in this case, will be able to gain access to huge amounts of information with all the ensuing consequences.

However, the development of cloud technologies has received a new impetus in the last decade, and today it occupies a large niche in the field of information

technology. According to Forrester Research, the global cloud computing market will reach $ 241 billion by 2020 (Figure 1), while the market for cloud applications and services via the Internet will grow to 159.3 billion dollars by this time (Fig. 2). At the same time, the average annual growth in the cloud computing and services market will be more than 20%.

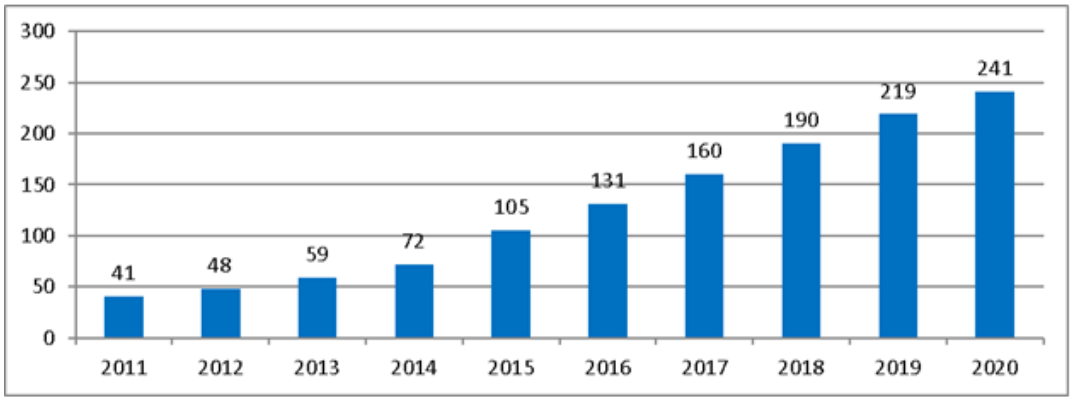


Fig.1. The volume of the world market of cloud computing (billion dollars)

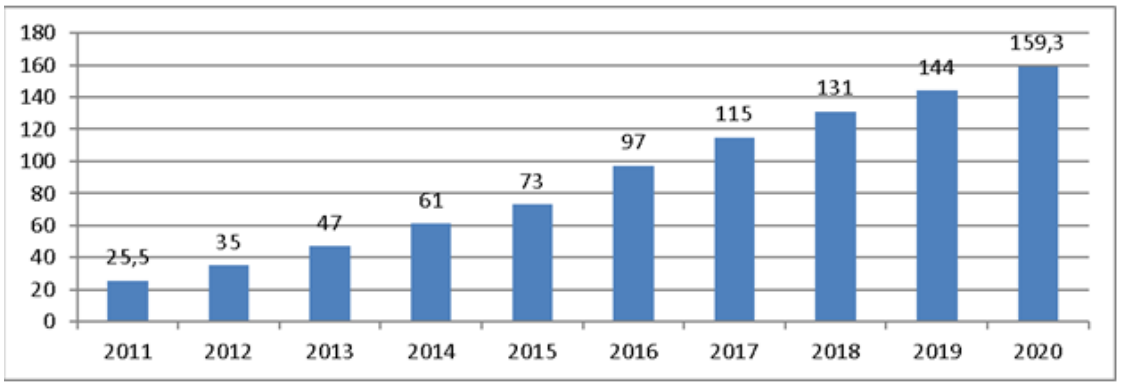


Fig.2. The world market of cloud applications and services (billion dollars)

The research defines and analyzes the world market of cloud technologies. A number of advantages and disadvantages of using cloud storage were presented. The greatest preference in the Ukrainian market of cloud technologies is given to the services of IaaS and SaaS. According to the forecast of the analytical company Forrester Research, we can say with certainty that "cloud technologies" will continue to develop, because already now they provide users with ample opportunities without the need to have powerful hardware in business and in everyday life.

Maksim Kulykovskiy
V.I.Shevchenko, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Boiler Automation System for Thermal Power Plant

Thermal power plants (TPP) take important place in energy generation all across the world. For example, more than 65% of India's electricity comes from TPP, with about 85% of them being coal-based.

Boiler is one of the most important equipment in any TPP, which require continuous monitoring and inspection at frequent intervals. However, despite all the efficiency that TPPs provide to us, working with superheated steam may be dangerous for human life. In addition, there are possibilities of errors at measuring and various stages involved with human workers. Therefore, to reduce the possible harm and to increase the reliability of facility, following automation solutions need to be involved to perform procedures without human assistance.

A reliable monitoring system is necessary to avoid catastrophic failure, which is achieved by Programmable Logic Controller & Supervisory Control and Data Acquisition system. PLC and SCADA interfaced via communication cables. The initial phase of automation focuses on passing the inputs to the boiler to constantly maintain a particular temperature. SCADA is used to monitor the boiler temperature, pressure and water level using different sensors and the corresponding output is given to the PLC. If the temperature and pressure inside the boiler exceeds the predefined value then the entire system is shut down. In case of emergency different automated check valves are used to release pressure, steam and inform the concerned authority through alarm.

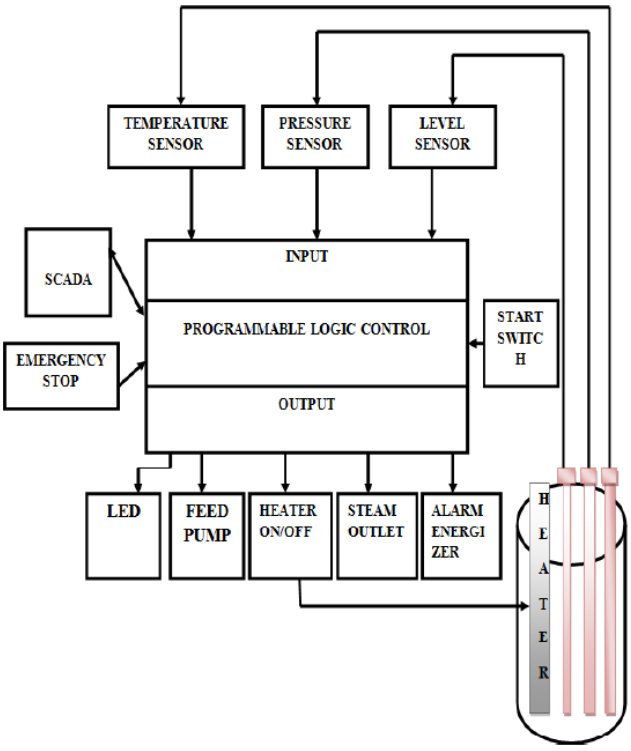


Fig. 1. Block Diagram of Boiler Automation

Figure 1 shows the block diagram of boiler Automation which consists of PLC, SCADA and sensors to monitor and control the operation of boiler. Here Resistive Temperature detector is used to measure the temperature, RT pressure switch is used to measure the pressure inside the boiler and float switches are used to detect the feed water level inside the boiler.

Water plays a major part in the generation of steam. Initially Pushbutton is switched ON then the PLC, SCADA, different sensors are switched ON. Feed water pump is switched ON by using feed water pump switch. Coal from the coal chamber passed to the water tube boiler. And the water from the water tank is allowed to pass through two parallel pipes to boiler and its temperature is measured. In one pump the flow rate is maintained at 130% and in another it is 75%. Thus the failure of any one pipe does not affect the boiler operation. Heater is switched ON by using PLC. Forced draft fan is used to force the air into the boiler to improve the combustion efficiency and its corresponding temperature and pressure are measured by sensors. The water is passed through economizer, thus the heat in the outgoing gases is recovered, by transferring its heat to the water. Then the heated water is made to flow through steam and water drum. In this, water should be maintained at least at 50%. For sensing water level Float switches are used. When the level is lesser than or greater than 50%, Float switches senses the level change and sends the appropriate control signal to the PLC. Thus, in spite of any changes in disturbance variable, the water level can be maintained at 50% by proper tuning of PID controller. Water in the water drum is maintained at more than 75%. When the water is less than 2000 liters then motor will be switched ON. If the temperature and pressure inside boiler exceeds then entire system will be in OFF state. The corresponding automated check valves are opened to avoid catastrophic failure.

Technical design of TTP boiler automation is completed and the last step before installation on the facility is to choose the proper component parts.

The importance of TPP automation is difficult to overestimate because it not only provides an increased efficiency and lowers the fuel consumption but also gives a safety to its workers.

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Pavel Kundenko
A. A. Martynenko, research supervisor
V.V.Zabolotnikova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Computer viruses and safety of our personal data

Every day, our life is becoming more and more digital. Every day thousands of viruses are created and the problem of our personal data safety becomes very important. Definition of a computer virus and what are viruses created for.

A virus is a piece of software designed and written to adversely affect your computer without your knowledge or permission. In more technical terms, a virus is a segment of program code that implants itself to one of your executable files and spreads systematically from one file to another. Maybe, you want to ask: “What are they created for?” Obviously, the goal of the virus creators is profit. They can get it in different ways. Some viruses steal your data, install some software or even remove your files. Population of Ukraine felt cyberattacks in the summer of 2017 when worm-style virus named Petya attacked thousands of computers. It blocked personal data on computers and required money to unblock.

Types of computer viruses and ways they can effect your computer.

Just like bioviruses, computer viruses come in many forms and can affect your machine in different ways. Now, there are the following types of viruses:

- A Trojan disguises itself as a document or file of interest, for example a song for a music lover, a new patch for an MMO for gamers or a picture/video. These viruses do not multiply but make your computer’s protection weaker and thus makes your system more susceptible to viruses and other kinds of malicious software;
- The worm-style virus is a program that, once inside your system, multiplies and scans for flaws in your security systems and protection. The worm-style virus attempts to spread itself through a large network by flaws that it finds or by sending itself through the network to other computers;
- Email virus uses emails to send itself to other computers and spread itself. They often forward themselves from infected computers.

Protection against computer viruses. How can we protect our computers against computer viruses? One of the most obvious ways but at the same time effective one is using an anti-virus. Having been specifically designed to combat the viruses any good anti-virus will regularly scan your computer at routine intervals that you can set as well as downloaded files and hard drives for viruses.

The second, it is important not to forget to back up important data. Get the habit to save important data to Cloud Data Storage, like Google Drive or to removable storage device. And the last one, it is highly recommended not to open emails from unrecognized sources, trust USB sticks, let strangers use your system, install software from random websites.

In conclusion, I want to say that prevention is better than the cure, so take steps to ensure the security of your computer now.

Roman Logvinov
V.V. Tkachov, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Artificial intelligence in design. Designers no longer needed?

Recently, artificial intelligence technology has been introduced everywhere, even in those industries where it is not expected. These include design.

It is difficult to imagine how machine learning or artificial intelligence can be used in a creative and personalized process, such as creating a logo or a website. But even this can already be done thanks to services such as Logojoy* and the Grid*, where the customer only needs to feed some data, such as the name, slogan, gender and scope of his company. AI based on certain algorithms generates an infinite number of options, selecting the most appropriate fonts and color palette. The customer will choose the most suitable, and will be able to edit it with the same AI by perforce. The whole process will take only a couple of hours in total, which is appreciably less than it would take for the designer. Such services suit you if you are looking for a simple, working logo. If you are looking for complex, original works, the best variant will be the designer, for the reason that he can invent something completely new, which no one else has done, while AI follows the given algorithm. However, in the future a more advanced AI will also be able to create something new and unique.

There are two ways for the designers to evolve in the future:

1) Move to the side of AI, learn programming languages and supervise AI, creating new algorithms, and if it is necessary – make adjustments to the design.

2) To go out to the top of the market, working for high-end brands. Such professionals will always be chosen with a greater desire than automation.

As can be seen, it is very simple to fall over by artificial intelligence and usefulness of this system, but we must remember that the result of its work will depend of the entered data. Nevertheless, when people and computers work together, new peaks can be reached that neither side would reach alone.

Valeria Marchenko, Oryna Kysilova
V.I. Mishkov, research supervisor
I.A. Ivanchenko, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

OWASP AND Top 10 Web Risks

The Open Web Application Security Project (OWASP) is a worldwide not-for-profit charitable organization focused on improving the security of software. It forms 10 risks that can disrupt applications. In 2017 there appeared the updated list of vulnerabilities compared with 2013. They are: Injection, Broken authentication, Sensitive data exposure, XXE (XML External Entities), Broken Access Control, Security Misconfiguration, XSS (Cross-Site Scripting), Insecure Deserialization, Using Components with Know Vulnerabilities, Insufficient Logging and Monitoring Injection is an action, when attacker has the access to database in web application by the injection a part of his code. The danger lies in fact that he can change, delete or add confidential information. Broken authentication and Session Management are methods to get your identifier from browser during your session or after it, if you log in your account and don't complete your session. It can be a problem when you visit a bank site or an online store.

The problem of sensitive data exposure is that information you write in web application is not protected by the certificate SSL (HTTPS). This means that your data are not encrypted and attacker can get and read them. XXE is a vulnerability that gets attacker an opportunity to receive important information from web-site by using document in XML format uploaded to this site. Broken Access Control often provides an administrative right and ability to modify information as admin. The trouble is that this vulnerability cannot be detected by automatic testing. When settings are default it causes Security Misconfiguration which also can lead intruder to access with administrative rights. XSS is an action when attacker integrates a special script in browser of victim when the last one visits some page and this script is running during this visit. Intruder can steal information, for example, by this method. Insecure Deserialization leads to denial of service(DoS). Serialization is the process of translating structures into series of bits. And deserialization is an inverse method. DoS is a result of exhaustion of memory resources by flood caused by this issue. Using Components with Know Vulnerabilities is also dangerous. Different libraries which you use in your web application can be with vulnerabilities. The difficulty is that you may not know about this and, moreover, a lot of people use these libraries too and have the same consequences. The last problem in this list is Insufficient Logging and Monitoring. The most important is to provide system monitoring in order to avoid problem listed above. But of course, it is not a solution of problems where practical actions are involved, as with a XSS, XXE and so on.

To sum up, there are a lot of troubles of most web application. For this reason, pentesters, people, who make a penetration testing in order to identify problems and point them out, will be of great help with reducing the number of successful attacks, as well as maintaining the web application at the proper level.

Yevhenii Molchanov
V.I. Mieshkov, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

«Man in the Middle» Attack: How to protect?

With the development of information technologies, the problem of information security is growing. In the first place, it is worth highlighting the problems of poor education and gullibility. The so-called «black hats» try to use these gaps.

A «Man in the middle» attack assumes that the intruder is built into the network between two people who exchange messages. The main purpose is to monitor all messages and modify them if necessary.

This method of attack is quite easy to implement if you use the unknown source for access to the Internet, for example, a free Wifi in a shopping center. There are no guarantees of network security. «Black hats» can be integrated into any network and become an intermediate link between the user and the Internet.

An attacker can easily attack an intermediary using a technique called ARP spoofing. Anyone on the Wi-Fi network can send you a fake ARP packet and because of that the users will unknowingly send all the traffic through an attacker instead of a router.

Modern SSL uses a suitable encryption algorithm, but it does not matter, if it is implemented incorrectly. If «black hats» intercept a request, it can be changed by deleting the "S" from the requested URL, thereby bypassing SSL.

How can users detect a «Man in the middle» attack? A time delay check can potentially detect an attack in certain situations, for example, with lengthy computations of hash functions, which are performed for ten seconds. To identify potential attacks, the parties verify the discrepancies in the response time. Suppose that two parties usually spend a certain amount of time to perform a particular transaction. However, if one transaction takes an irregular period to reach the other party, this may indicate interference by a third party that introduces an additional delay in the operation. To detect a "man in the middle" attack, you also need to analyze network traffic.

How can users be protected? First of all, it is better to use the verified Internet access and SSL protocol, which forces the attacker to do a great job to commit an attack. Users should be always on the alert protecting their browsers and computer to prevent the insertion of a fake certificate. However, it is almost impossible to be protected from professional hackers.

Tatiana Nekludova
A. A. Martynenko, research supervisor
V. V. Zabolotnikova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Quantum Computer

A quantum computer is a computing device that uses principle of quantum superposition and quantum entanglement to transmit and process data. Such computer (unlike the usual one) does not operate with bits (capable of taking the value either 0 or 1), but with qubits that have values of 0 and 1 at the same time. As a result, it can process all possible states simultaneously, achieving a superiority over conventional computers in a quantity of algorithms.

Quantum entanglement. This theory denies the locality principle, which exists in classical physics. Quantum entanglement involves the interrelation of two or more particles that can be located anywhere in space. A record long distance, where two separated from each other particles were interconnected, is 1 m. It also suggests that to obtain the results of these particles' system, it is necessary to change it.

The history of the quantum computer. Richard Feynman proposed one of the first models of a quantum computer in 1981. Soon Paul Benioff described the theoretical basis for building such a computer. In addition, Stephen Wiesner suggested the concept of a quantum computer in 1983 in an article (Conjugate coding & Dance of the Photons: From Einstein to Quantum Teleportation), which he tried to publish for more than ten years before.

Benefits: Using the technology of quantum computer will help to find solutions for problems that require long calculations from classical ones. Such tasks include, for example, cryptography, artificial intelligence systems, optimization of complex systems, comparison operations, and other problems for which humanity now lacks computing power (chemical design of drugs, cracking of any encrypted data).

Disadvantages: The problem of inaccuracies in computing belongs quantum computers. In addition, the exchange of information between qubits and the outside world is complicated. However, these problems can be solved by developing science and overcoming some physical principles, which in itself is also a problem. Disadvantage for the user are an incredibly high price and huge dimensions. With the course of time these powerful machines might come mobile, as it happened to PC in the past.

A quantum computer is a powerful computer that directly depends on scientific progress and development in the field of modern physics. Computer like this already exists but possessing only a tenth part of all the possibilities of a theoretical quantum computer. So this sphere of investment is very profitable, and, probably, soon we will be able to use new and powerful devices like we use our PCs nowadays.

Sergei Pavlov, Nikolai Angelovskiy
G.M. Saksonov, scientific supervisor
I.A. Ivanchenko, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Viruses Wannacry vs Petya

The largest cyber attacks in Ukraine in the spring of 2017 became known as «Petya» and «Wannacry»; both of them are similar but have some differences. Considering the way they originated and spread, we can think more about further protection against them.

«Wannacry» started on May 12 with sharing harmful archives (Word documents, PDF files) on e-mail addresses through the updating of M.E.Doc programs. Many countries were attacked, but the most infected computers appeared to be in Ukraine, Russia, Taiwan, Britain, Spain and Germany. Unlike «Wannacry» that had advance warning of the mass mailing, «Petya» was a surprising “gift” for Ukrainian banks, state-owned enterprises, mass media etc, having blocked them for a long time. According to ESET, the developer of the antivirus software, the listed below countries suffered from the «Petya» virus accordingly: Ukraine 75.24%, Germany 9.6%, Poland 5.81%, Russia 0.8% and other countries - 8.55%.

The attack by the virus «Petya» was directed to cause the maximum harm to the Ukrainian state (damage to the systems, interfering with the operation of infrastructure, hacking and destroying the data), as well as enriching the so-called "extortionists". The virus attack of «Wannacry» was not targeted at specific area. This was the case of the so-called fan-attack, when the virus "attacks" absolutely any access to the computer, encrypting the data and then displays a message about converting files with a proposal within 3 days to pay the decryption key in bitcoins in the equivalent of $300 to unlock the data. If the ransom does not get paid, the amount will automatically be doubled. On the seventh day the virus will destroy the data.

In the case one’s computer was susceptible to an attack and when starting it, the message "Windows is locked, you need to send money on this virtual wallet” appeared on the screen. The problem cannot be solved by paying money, but anyone might easily fund crime. It is recommended for users and companies not to follow the criminals` requirements. In order to restore the operation of one’s computer, various services were developed from the producers of Dr.Web anti-virus, Kaspersky ESET NOD32. To get the unblocking code, one just needs to know any of the listed things: either the text of the sms that the virus requires, the name of the virus itself, or the screensaver exterior that asks to send money.

Summing up the above mentioned, we can say that companies should take the security of their data more seriously. Every year more and more vulnerabilities are identified in the programs that most companies work with. To reduce the systems weakness, the creators of such programs as M.E.Doc should test their products programming code on safety more carefully.

Ilya Razumovski
N.V. Kozar, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Pros and Cons of Computer Games

Computer games give people the opportunity to move into a fantasy world. Excellence over cinema, theater, books and games is guaranteed through their interactivity: games are involved in joint activities, the player actively influences current events. So, the main task of the creators is to build this world.

The article by American programmer Mike Stout tells about all the subtleties of creating games states that there are a lot of theories about what a game is, and while most game designers will agree on certain aspects, there has never really been a solid answer.

There is a universal opinion, a game without challenge is not a game but a toy. This does not necessarily have to be a disadvantage, however, as both Minecraft and the Sims are both fantastically popular and tend to fall more under the "toy" category. Games can also contain toy elements within them. The author gives the following example: Spore is a game wherein you design a species to go from microscopic life to space-faring race, but for some people simply creating wonderful monsters within the creature creator was enough.

It is tempting to think of “bad challenge” as making the game too easy or too hard. The expert claims that this is an important part of the game design.

A challenge has to be fair to the user, and that means not only setting the difficulty at a reasonable level, but ensuring that the player can be reasonably expected to complete it.

Meaningful choice makes a challenge interesting. When we go into a game, we expect to make choices, and for these choices to affect the game. Gaming is a skill like playing an instrument, it can be improved with practice over time. Therefore, it is reasonable to assume that most of us are good at gaming.

So the author claims that, when he designs games, he needs to decide how difficult it is going to be. All players want to play a game that provides a challenge,

but that challenge is relative to the skill of the player. So, answering the question ‘what makes a game hard’, it should be noted that a lot of things do: be it devious puzzles and tests of skill, or lengthy boss battles and pixel-perfect jumps.

The distinction between "fun hard" and "unfair hard” is complicated for all players are different. Programmer says that at the beginning of a design, the hardest part is figuring out what is going to be in a level. As a designer, you get to decide a lot, but you don't always get to decide everything—especially if you're working in a large team.

The platform you make the game for imposes constraints. The most interesting is that a game for a phone can't use as much processing power as, for instance, a game for PS4 or PC. A virtual reality game imposes restraints on camera movement to avoid causing motion sickness. Author of the article says that mobile games have length restrictions because people play in short bursts. The author states that critical questions vary from project to project, but regardless of whether he is designing a level for himself or for others, he finds that there are four main questions that are almost always the most important to ask first:

What is required by the level's story, theme, and plot?

What are my set-pieces?

What metrics am I constrained by?

What does the game's "Macro design" require from this level?

Summing up, it should be noted that the games began to take a lot of effort and resources in their creation. Fantastic pictures of their beauty provide a world that is closest to reality. And to create such a game, specialists are forced to go through many stages.

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Vladimir Rud
G. M. Korotenko, research supervisor
L.A. Zaika, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Computer Graphics and Virtual Reality

VIRTUAL REALITY (VR) – is a three-dimensional (3D) surrounding world created with the help of technical means and software provided to a people through their senses: sight, hearing, smell, touch, etc. VR simulates both impact and response to the impact. To create the sensations of reality, the computer synthesis of properties and reactions within the interactive world, all the synthesis processes are calculated, analyzed and performed in real time. Don't confuse VR with augmented reality (AR) The significant difference between the VR and AR is that virtual reality constructs a new digital world, but AR adds individual artificial elements to the perception of the real world. Systems of "virtual reality" are devices that are more clearly compared to conventional computer systems that allow you to immerse into a virtual environment, by affecting all the human senses.

Image output. Nowadays, there are several types of gadgets that allow you to display and generate images in VR systems.

Head Mounted Display (HMD) – Modern helmets of virtual reality are more likely glasses than a helmet, and contain one or more screens, as well as a tracking system that tracks the orientation of devices in space. As a rule, tracking systems for virtual reality helmets are developed on the basis of gyroscopes, accelerometers and magnetometers. *MotionParallax3D-displays* – The class of VR devices that form the user's illusion of a volumetric object due to the output to one or more displays (having different sizes, shapes and relative positions) of specially generated projections of virtual objects generated based on the position of the user's eyes, relative to the displays, the image changes. All systems of this type use the visual mechanism of perception of the volumetric image of the parallax movement (Motion Parallax). The tracking systems for the MotionParallax3D - displays track the coordinates of the users eyes in space. *Virtual retinal display (VRD)* – Such devices form an image directly on the retina of the eye. As a result, the user sees an image "hanging" in the air in front of him. Devices of this type are closer to the AR systems, since images of virtual objects that are visible overlap with images of real-world objects. Nevertheless, under certain conditions (a dark room, sufficient coverage of the grid), devices can be used to immerse the user in VR. At the moment, the most perfect systems of VR are projection systems made in the layout of a room of cave automatic virtual environment (CAVE). Such a system is a room in which on all walls 3D-stereo image is projected. The user's position and the turns of his head are tracked by tracking systems, which allow to achieve the maximum effect of immersion.

Sound. *3D sound* – is an integral part of virtual reality. It differs from the so-called "surround sound". When a person at home watching a video connected to a

surround sound system, the sound is heard in the front, side and rear speakers. If the viewer moves to another place, the sound won't change its direction. The distribution of sounds in VR is usually carried out by stereo headphones, which process sound - imitate human ears. That's why, it creates a feeling that sound comes from everywhere.

Imitation of tactile sensations. Imitation of tactile or tactile sensations has already found its application in VR systems. These are so-called closed-loop devices.

Gloves of virtual reality – Gloves allow you to experience a tactile response when interacting with virtual reality objects. Tactile system consists of three main components: *The Leap Motion sensor* – its function is to determine the position and movement of the user's hands. *Mckibben muscles* – latex cavities with woven material that respond to movements created by the movement of the user's fingers; a distribution board whose task is to control the muscles themselves, which create tactile sensations.

Control. In order to recreate the user's contact with the environment more accurately, the user's interfaces that most realistically match the simulated ones are applied: a computer steering wheel with pedals, a device control handle, a gun pointer, etc. VR gloves can be an integral part of a VR suit that tracks the change in the position of the entire body and also transmits tactile, temperature and vibration sensations. Also, the user tracking device can be a freely rotatable ball into which the user is placed. The devices described above affect the sense organs of a person, but the data can be transmitted directly to the nerve endings, and even directly to the brain via brain interfaces.

Application. VR is used in such areas as: *Military Industry* – used to train soldiers, simulate fights. *Training* – 3D reality allows simulating the training environment in those areas and for those classes for which the preliminary preparation is necessary and important. As an example, it can be an operation, management of equipment and other areas. *Games and Entertainment.* The most common are all kinds of attractions of VR – is an VR for PC: 3D games and simulators (for example, avia and autos simulators, real life simulators). Various events are also in demand. *Architecture* – it is used to recreate future buildings and their elements, to model the interior.

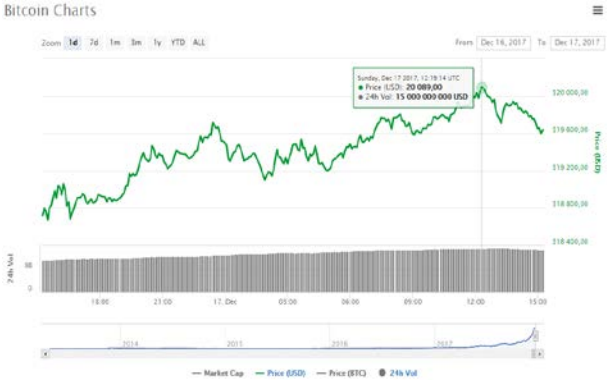
Despite the already impressive achievements in the field of VR modeling, it is too early to talk about the full reproduction of the real world: a complete 3D VR is not yet possible. Even the most advanced devices VR, providing the transfer of sounds and images, actions and tactile sensations, can't yet provide the full effect of immersion in VR, which completely repeats the reality. But progress does not stand still, with each year there are new technologies and improved devices for VR, including a VR for the smartphones.

Yehor Rud
G.M. Saksonov, research supervisor
I.I. Zuyenok, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Bitcoin: Secrets of Success

Appeared in 2009, bitcoin has gained its popularity within a short period of time. If it at the beginning, no one take this cryptocurrency seriously, nowadays its rate reached thousands of US dollars. It would be appropriate to find out the reasons for so high popularity of a bitcoin, to determine the range of their use by examining five main philosophies of cryptocurrency and original know-hows of bitcoin emerging and its promotion.

Bitcoin is a new currency that was created by an unknown person using the alias Satoshi Nakamoto. Transactions of bitcoin are made with no mediator that is meaning: no banks! The range of bitcoin use is wide. It can be used to book hotels on Expedia, shop for furniture on Overstock and buy Xbox games, but much of the hype is about getting rich by trading bitcoin. Bitcoin rates has skyrocketed from $ 900 to $ 20,000 in 2017, but at the beginning of 2018 it was about only 11,000 US dollars.



There are five main philosophies of cryptocurrency:

1. **decentralization**: The are no geographic borders to the currency.
2. **anonymity**: Nobody need to know about one's transaction.
3. **forgery**: There is no "duplicate money".
4. **controlled supply**: The maximum number of bitcoins that will ever be mined is 21 million bitcoins.
5. **security**: currency is protected by math.

Cryptocurrencies, as the name suggests, are protected by cryptography known as an art of keeping secrets from your enemies using mathematics or at least attempting to do this. The type of cryptography bitcoin uses (called "one-way hash function") is like a one-way digital portal — or a digital trapdoor. You can put data through it and the cryptographic function (complex math formula) transforms it into something incredibly unfamiliar from its original state. So unfamiliar that it's impossible to undo by working backwards. To sum up, bitcoin being one of the modern cryptocurrency can be considered the best currency for investing that is provided by its full anonymity, decentralization and safety.

E. A. Shcherbakova
V.I. Mieshkov, research supervisor
S.I. Kostrytska, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

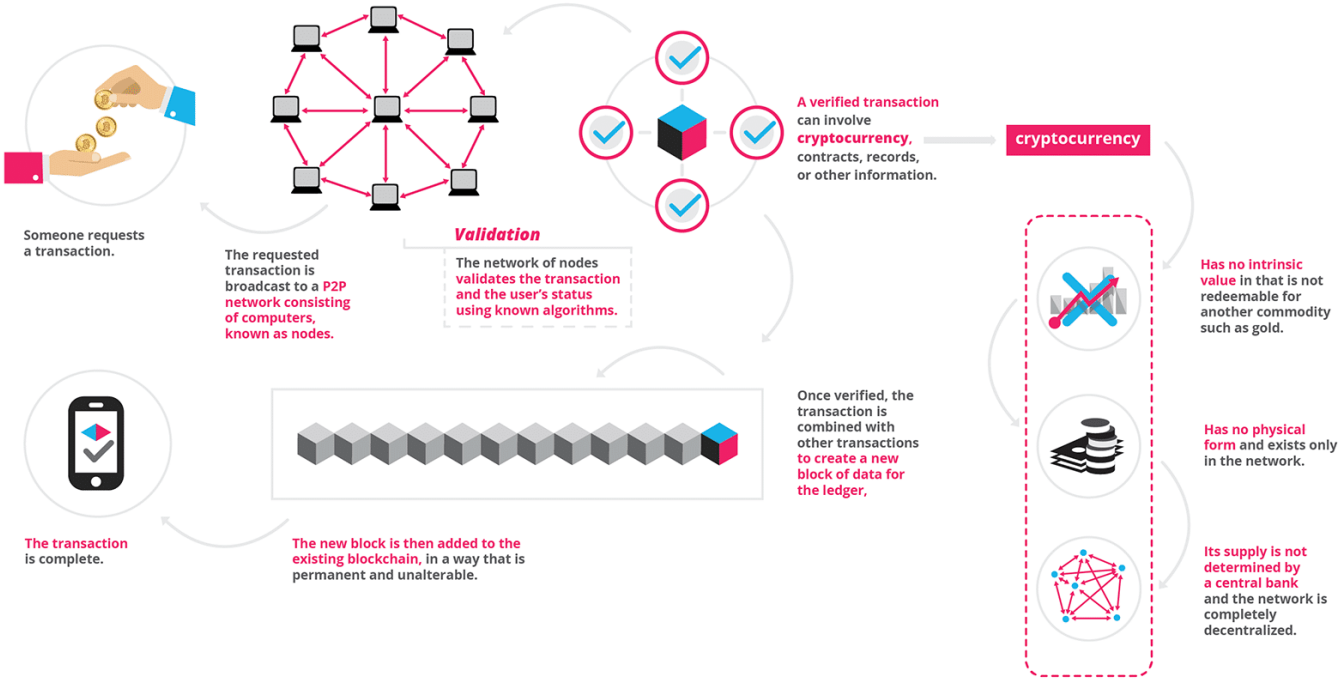
Cryptocurrencies Based on Blockchain Technology

Blockchain is a database of all transactions that are made in some system. It is stored as a chain of encrypted blocks on all computers connected to the system. Each new data block joins the previous one and is verified by the network participants. It is impossible to forge data in such a system, if there are a large number of decentralized computers.

The mining of bitcoins involves solving some complex crypto problems by creating a block of data in the chain. The bitcoin system is designed in such a way that you can "get" a new block once in ten minutes. To comply with this rule, the complexity of computation increases. Therefore, no matter how many computers in the world are working on the task, they will not be able to create a block faster.

Initially, this work was reimbursed in 50 bitcoins (BTC), shared among all participants in proportion to their contribution to the common deal. The reward is reduced by 50% when 210,000 units are obtained. Today for each block the miners collectively receive 25 BTC. Because of the periodic reduction of the award, the total number of BTC will never exceed 21 million. Nevertheless, bitcoin can be divided up to 8 decimal places (0.00000001), so this will not be a problem.

(Figure 1. Blockchain Technology)



The prime cost of mining (i. e. the cost of equipment, and electricity) is growing all the time. Nowadays, large computing power is required for bitcoin mining, so that it is useless to do mining on PC. This factor creates the internal cost

of bitcoin. It consists of the cost of equipment that is amortized during the time of mining, electricity spent for these operations, physical and intellectual costs.

This year, bitcoin has soared in price, rising more than 1000% against the dollar. This has caused the increased interest from investors and financial leaders. The EU and UK authorities plan to deal with bitcoin, as problems with the use of crypto-currency are growing to facilitate financial crimes and money laundering.

The main difference between the conventional money and bitcoin is that any modern currency is an obligation of the central bank issuing it. Bitcoin is called “digital gold,” and for a good reason. Its volume has a limit, it has an intrinsic value, and the main advantage over modern currencies is that bitcoin is not a debt. In addition, blockchain technology protects the crypto currency from various kinds of falsifications, counterfeits and fraudulent transactions. The main things about using cryptocurrencies are shown on figure 1.

Blockchain gives the world a new form of money, stable to inflation, completely decentralized and protected, but not yet recognized by most states and having a hard-to-forecast speculative exchange rate.

The advantages of crypto currencies are the following: almost zero cost of transactions, the ability to conduct financial transactions without any intermediaries and related commissions, the availability of money at any time (it is impossible to freeze the account), transparency or anonymity of transactions where necessary, no inflation.

The lack of a single central administration in the system can also bring some problems. Insecurity with real assets turns the crypto currency into an extremely speculative tool, which is also not sufficiently protected from the actions of hackers at the user level. Finally, for the state, the anonymity of the owners of electronic wallet creates the risk of withdrawing significant funds into shadow economy.

In addition, the use of Bitcoin in the shadow economy makes it possible to ensure that national authorities do not control the trade in such goods as weapons or drugs.

These pluses and minuses are a consequence of the fact that the legal status of Bitcoin differs in different countries, although no country has officially recognized it yet, having fixed it in the legislation.

Cryptocurrency influences economy a lot. Bitcoin brings with it two ideas. The first idea is that an easily convertible financial asset can be issued not only by the government. Thus, crypto-currencies are a new round of development of the idea of private money. The second idea is the economic freedom of the Internet. Blockchain allows users to create various systems of storage and circulation of assets that are not connected to any central computer. The internet receives not only the opportunity to freely disseminate information, but also will be free to handle money resources that are not dependent on any state.

Nikita Shevtsiv
N.O. Karabut, research supervisor
N.O. Holiver, language adviser
Kryvyi Rih National University, Krivyi Rih

Modern Android Technologies

According to Google 2017 statistics, 2 billion active devices are run on the Android platform. Virtually every citizen of Ukraine has or had such a gadget. But not many people thought about how it can be used in addition to calls, paging tape in Instagram or listening to music.

In this article, we are going to consider the benefits of our gadgets in combination with other devices that will greatly facilitate our lives - so called lifehacks.

Many (if not all) parents of small children are constantly worrying of their child. Some people constantly think: "Is my baby breathing?" and to calm down, mom and dad run every 5 minutes into the room to check the baby. When they are convinced that yes, they are breathing, the temperature of the child is normal, the cot is checked. Sproutling is a system that monitors the child's condition and keeps track of what surrounds him/her. The Sproutling system consists of two parts. The first is a bracelet, made of hypoallergenic plastic, which is put on the baby's leg. The developers claim that the bracelet does not cause any child's negative feelings. In the bracelet, there are several sensors, including a heart rate monitor, an accelerometer, and a temperature sensor. The second part is the base station, in which there are some more sensors and a small camera. The station determines the noise level, temperature and humidity of the room, the level of illumination. In addition, the same station also serves for wireless charging of the bracelet battery (for which the bracelet should simply be put on the docking station).

Among the 14 platform nominations for the Silicon Valley Product Hunt there were seven products from Ukraine, three of which received a "golden kitty."

Sproutling allows, if not completely, then partly to remove anxiety: the smartphone screen with indicators can be watched every 5 seconds, and the baby will not be hurt, and the parents will be calm.

The smartphone powered pet food Petcube Bites won in the nomination "The Strangest Product of the Year".

Petcube is a home robot that is designed to entertain pets when their hosts are away. The device has a built-in microphone, speaker, wide-angle camera and a movable laser pointer. When the cube is connected to a home Wi-Fi network, the user, while away from home or apartment, can send commands to the device through a mobile application and communicate with his pet.

Thus, we can conclude that for a modern human Android devices are an integral part of everyday life.

Anna Shumylo
T. A. Zheldak, research supervisor
N. M. Nechai, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Artificial Neural Networks in bioinformatics

The growth of technologies in bioinformatics caused an explosion in the complexity in generated data. Thus, it requires new algorithms of data processing. Artificial neural networks are a form of machine learning from the field of artificial intelligence with proven pattern of recognition capabilities. They have been utilized in many areas of medicine and bioinformatics. Neural networks are able to solve such problems as disease classification and identification of biomarkers. This review introduces and describes the concepts related to neural networks, the advantages and disadvantages to their use in general and in bioinformatics particularly.

Analysis of DNA composition is the one of the most important tasks of today's bioinformatics. It requires a lot of difficult steps to identify and validate special parts which are related to appearance of some diseases – biomarkers. Despite the existence of a significant number of high-throughput technologies, there remain a lot of diseases without any identified biomarker. There are a lot of reasons for it. First of all, the amount of input data is too large. Frequently the total size of input files in text format is dozens of Gigabytes! For example, the total size of 500 sheets with text only is just about 25 Megabytes. The second reason is that input data is often extremely noisy. Sometimes just about 1% of information contains something representative, the rest are parts of DNA which became unnecessary in the course of evolution. The other reason is caused by high complexity of biomarkers recognition. Existing methods require expensive high-performance hardware and equipment.

Thus, it is clear that the identification of new biomarkers still requires a concerted, multidisciplinary effort. One of the ways of solving these problems is using Artificial Neural Networks (ANNs). Artificial neural networks or connectionist systems are computing systems vaguely inspired by the biological neural networks that constitute animal brains. ANNs are already highly used in wide range of life areas, including medicine. The reason of this is that ANNs are coping with large datasets with difficult dependencies and high level of noise.

As stated before, ANNs are based on the brain's way to process information. This feature gives a lot of advantages to ANNs versus classical parametric analysis methods. First, they do not rely on data to be normally distributed. Moreover, they are able to recognize difficult non-linear relationships in data that is often too complex task for classical methods. Furthermore, ANNs are almost not sensitive to deficiencies in the source data. They have the ability of handling noisy or fuzzy information. Moreover, it is not a problem for ANNs to cope with incomplete data or data which contain missing values.

To make a Neural Network work correctly it almost always needs to be trained. However, it is the other advantage of ANNs, because trained network can interpret

information which is different to that of the training data. It means that they are able to predict future cases or trends based on what they have previously seen. Thus, trained ANNs can be used in diagnostic of some new unknown cases which are quite similar to cases that are known before (cases from one class).

Finally, there are several techniques that can be used to extract knowledge from trained ANNs. Moreover, the importance of individual variables can be easily recovered using various methods. This, from a biological perspective, is perhaps one of the most useful aspects of ANN modeling.

The unusual feature of most of biological datasets is that there are a lot of input variables and relatively small number of cases. With the increase of input data dimensionality, it becomes much more difficult to find best values for input variables. This deficiency has been termed “the curse of dimensionality”. It often leads to a source data with many inappropriate or noisy inputs. In turn, this complicates the process of identifying truly important biomarkers with predictive algorithms. The theory says that a valid representation of the population one should have a model where number of cases is more than number of input variables, sometimes even 10 times more. Thus, it’s necessary to use some form of dimensionality reduction/variable selection algorithm. Otherwise dataset will be too large and using of such set is not feasible.

The other problem of ANNs is that they belong to the black box model. The principle of the black box model is the following: you have input data, and you can see the output. However, the data processing is hidden from you, and you can’t exactly say how the received result is obtained. In turn, the white box model is the opposite of the black box model. Since many studies are connected to patients’ health, it is crucial to change the black box into the white-box providing logical reasoning just as clinicians do for medical treatments. Transformation of deep learning from the black-box into the white-box is still in the early stages. One of the most widely used approaches is interpretation through visualizing a trained deep learning model.

In conclusion, I would like to say that the rapid growth of technologies in bioinformatics causes the increase of data complexity. In turn, this causes the increase of the need for new processing methods. Artificial neural networks are one such approach, a robust tool able to process these datasets and identify the key components (biomarkers). It helps to better understand biological processes and shows new targets for future research.

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Volodymyr Shvets
Lutz Leutet, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine
Hamburg University of Applied Sciences, Germany

Developing a Communication Module with a Digital-To-Analog Converter

In the digital age that we are living now, there is the need in converting data between media. The aim of the paper is to describe experiment of designing an input-output module using a simple 3-wire serial bus interface that allowed interaction between 3 devices: the FPGA, the ADC and DAC modules.

During the experiment was developed a communication module with a digital-to-analog converter (Burr Brown DAC8801) connected via a 3-wire serial data interface to the FPGA. In order to achieve the communication, the message obtained from switches connected to the FPGA was serialized and set bit by bit via the serial bus. In the second step the output of the DAC module is connected to an ADC module analog-to-digital module (ADS7947) in order for the whole processing chain to be tested.

For the physical implementation and measurement was used an ADCDAC board, an APB board, the ML507 FPGA board, wires, an oscilloscope, probes and a signal generator [1].

In order to achieve the right communication timing, the DAC communication module sends an inverted clock to the DAC.

The message stored by the shift register is padded with ”00” on the left and right, because the first two bits are ignored by the DAC and the last two are a requirement. The simplified state diagram of the FSM is depicted in Figure 1. In order to “implement” the rising edge function an additional state was added to the code.

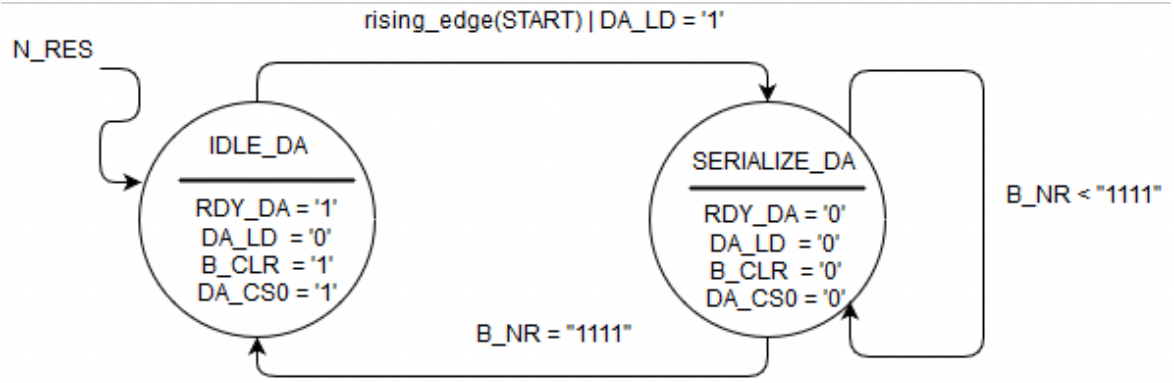

Figure 1. State diagram of the FSM of the DAC communication module

The top-level module ADCDAC_TOP was synthesized and the FPGA was configured. In order to load the message from switches, the M_ODE signal connected to the switch B1_S7 was set to LOW. The top-level module ADCDAC TOP was synthesized and the FPGA was configured. In order to load the message from the ADC into the ADC, the M_ODE signal, connected to switch B1 S7 was set to HIGH.

Voltage of 960mV was applied to the ADC input (ADC IN0), and the resulting frame from the ADC equal frames from the ADC to the DAC.

Digital values applied to the DAC and corresponding DC output voltages can be seen in Table 1.

Table 1

Digital	**Analog**
000_{16}	-1.080 mV
FFF_{16}	999.7 mV
$F00_{16}$	759.7 mV
$0F0_{16}$	-1.000 mV
AAA_{16}	279 mV

Thus, carrying out this experiment we gained experience of designing an input-output module using a simple 3-wire serial bus interface that allowed interaction between 3 devices: the FPGA, the ADC and DAC modules. Whereas internally every device processes data in parallel, the communication between them is done serially, this being possible due to the designed data stream conversion module.

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Pavel Sitnaykovskyi
I.G. Hulina, research supervisor
V. V. Hubkina, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

HTML / CSS Rendering via WebGL for Maximum Performance and Unlimited Animation Capabilities on the Web

Recently, a discussion on the topic "DOM is slow" has been actively circulated in the web developers' environment. This thesis is really just justified. Any change to the DOM creates a wave of events throughout the document and if desktop browsers can handle this load, then mobile and embedded systems often slip. Exactly the complexity of the DOM model that does not allow reaching the coveted 60 FPS creates delays in animations and in every way frustrating users and developers.

The most painful moment is the animation of the layers. Solving the problem of smooth animation is one of the main tasks of cross-platform Web development. Active research in this area has been going on for a long time (having received additional acceleration in 2011 after Facebook refused to develop a Web application), however, the first system solutions were received quite recently.

All of them are generally divided into two areas:

- Acceleration of classical DOM operations;
- Using alternative ways of rendering content.

And if the first branch as DOM acceleration already rested on the theoretical capabilities of modern APIs, then alternative rendering methods still have great undiscovered potential. One of the most significant achievements in the field of creating NO DOM applications was React-Canvas, using the Canvas API to display content, as it is understandable, while allowing you to operate text content and implement grids with React components <Surface>, <Layer> , <Group>, <Text>, <Image>, <ListView>.

This approach, which showed good results in terms of speed, suffers from congenital malformations that are probably incompatible with life. The best solution will be regardless of the specific framework and will have more polyphile properties for the speed problem. It will not offer the developer new concepts and components, leaving it to work in a familiar HTML / CSS environment. The world of game engines has long passed the stage of the competition 2d Canvas / WebGL. For several years, the latter's faster performance has been widely recognized. The ideal solution will be to use WebGL with a fallback on Canvas. A good solution will not deprive the developer of the DOM tree, because the tree allows you to monitor the status of the application, effectively debug and stylize the content through Dev Tools.

Based on this thesis, we began work on our solution to the problem of "slow DOM". The result of the research was HTML GL - a library that allows you to render HTML / CSS through WebGL, which does not require developers to learn a new subject area or bind to a particular framework.

How to work with HTML GL?

Connect htmlgl.js to the project. Use the name of the <html-gl> tag for the elements you want to animate. These elements will be displayed in WebGL, and their CSS Transform property will become the facade for transforming their WebGL views. The DOM element itself will not be displayed or animated. All transformations occur on the GPU and only affect the WebGL texture representing the element, which significantly reduces the amount of resources consumed. A distinctive feature of HTML GL is the presence of a hidden but up-to-date DOM tree that is often useful when debugging an application.

Examples:

- FX Demo WebGL is not only speed, but also limitless possibilities for effects
- Basic HTML GL demonstrates the use of HTML GL on simple content, animates the element using Velocity.js, as well as transforms through the CSS Transform
- Basic DOM is the same project, but HTML GL is disabled and all operations are performed on DOM nodes, you can notice that the layer is drawn again in the animation peak, which is equivalent to the delay on the mobile device
- Advanced content HTML GL slider with several levels of content nesting, displayed via HTML GL and animated Velocity.js
- Advanced content DOM

"Under the hood"

The main idea is to manage the rasterization of the HTML node and display the result of rasterization on a full-screen WebGL surface. It can be listed as following:

- A web GL element is created on the page;
- Its content is rasterized;
- It is displayed on a full-screen WebGL context in the form of a 2d sprite, while the DOM element itself is hidden;
- The element of style.transform is tied to its WebGL view and, when modified, transforms the WebGL view;
- When you change the content or component styles (DOM Mutation Observers / Events), it is rasterized again and the WebGL view is updated

It can be concluded that proposed scheme of work allows you to mix WebGL and classic DOM content within one application without limiting the developer in choosing a framework and not imposing learning additional APIs. Adding the <html-gl> is the only step to reach desired effect.

Viacheslav Solovyevskiy
V.I.Shevchenko, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Video games in education

Computer and Internet already long time embedded in our lives. Every month or even week we get new devices, concepts, prototypes, etc. Video games are the part of this progress, but nowadays we still got no determined opinion about them. Some surveys say that video games could be used in self education or employees training, some - that video games violence in society and cause mental problems in kids heads. So lets address to the elephant in the room and look at pros and cons of video games in educational and entertainment process.

In their “Towards understanding the positive effect of playing violent video games on children’s development” Adel M. Agina and Robert Tennyson provided the influence of violent video games on children via experiment and survey that took place in Libya. The author mention the result of surveys that demonstrates that number of kids could get violent arousal via games. They stress that nowadays there are an increased cases of kids playing violent video games without parental guidance. Moreover, the author suggests that this type of entertainment could be compared to double-edged sword, so there is not only negative effect. Finally, authors state that despite the negative effect of playing violent video games, violent arousal has positive effect on children’s development especially self regulation and thinking aloud to express their mind’s content. In conclusion should be mention, that many kids understand what they do in games, that they do something wrong, and most of them don’t want to do the actions that they do in video games.

Moving on, let’s look on the problem from parent’s point of view and how it could be trusted. In “Adolescent problematic Internet use: Is parental rating suitable to estimate prevalence and identify familiar correlates”. The authors mention the prevalence estimate for adolescent problematic Internet use in Germany as 4.7% and this associated with family functioning and higher frequency of parent-adolescent conflicts. This can be used by future research to expand the knowledge on problematic internet use in adolescence, for instance by collecting both parent and child self-report to gain a deeper understanding of the factors associated with this comparatively new phenomenon. In general, in some settings (e.g., treatment facilities) or for a first impression, it could be easier to assess adolescent problematic Internet use from a parent's point of view. But a standardized and validated measure is a necessary condition to avoid parental misjudgments.

Moving to third point and other point of view of this subject. In his “Video games can develop graduate skills in higher education students: A randomized trial” Matthew Barr shows the effects of playing commercial video games on the

development of desirable skills and competences sometimes referred to as “graduate attributes”. The author mentions that games used in the study were commercial titles, designed for purposes of entertainment rather than with intention of development particular skills in players. Author shows that students were more likely to show a positive score change. He suggests that game-based learning interventions have a role to play in higher education. Finally, the author states that there is a need for further, similarly robust study of the effects, and such work may only be hampered by ill-informed attitudes to the ubiquitous and immensely popular medium of video games.

And in the end of this text we’ll take a look at “Utilization of virtual reality in education of employees in Slovakia” by Monica Davidekova, Michal Mjartan and Michal Gregus. In this work authors point out the possibility of using virtual reality (VR) and augmented reality (AR) to train employees. The authors mention the result of surveys that demonstrates that 34% of all cases that employee get necessary skills by self-development and self-improvement. They stress that VR and AR could be used for development of some skills that employee needed but not in every type of industry. Moreover, the authors suggest that AR and VR could help in testing employees in situation that could be dangerous or too expensive in real life. Finally the authors state that AR and VR could solve the main problem of current used forms of education - monotony and deadness of training.

In conclusion, I could say that as for every entertainment industry, like movie, books, TV and music, there should be more studies and surveys. Video game is relatively young and new entertainment industry and old methods of measurement and studies, that was used for cinematography and literature is no longer relevant. Video games still should be perceived as double-edged sword with no distinct opinion about this subject. It all depend on what’s the purpose of individual game: some of them are only for entertainment, some educational but some of them could be both.

Kate Suslova
E.A. Zhukova, scientific supervisor
I.A. Ivanchenko, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Database protection

Many companies maintain electronic databases of their customers (stores, mobile operators, banks, etc.). As a rule, these are personal data of people as well as their confidential information. Such information should be reliably protected. Therefore, the issue of its protection is the most urgent for today because there are many situations of information leakage.

For example, everyone knows about the recent scandal with Facebook. It all began after the fact that one British company collected the data of 50 million subscribers without informing them. This is a violation of the rights of users and legislation in different countries. The head of Facebook Mark Zuckerberg did not provide proper protection of databases, which led to the leakage of people's personal data. Another example is Ukraine where the client base of the New Mail was hacked. And, despite the fact that the representative of the company denied the fact of hacking, there was discovered the sale of the details of 18 million people’s records (names, phone numbers, cities, series and number of passport, emails, etc.). Therefore, every company that has any confidential information must ensure its reliable protection. This is how we see it.

To protect any information (including databases), it is necessary:

1) Recognition (authentication) of users and used information processing components (use of personal passwords that need to be periodically changed);

2) Physical protection of the PC (when viewing / processing any information in the room there should not be any unauthorized personnel);

3) Differentiation of access to elements of protected information (this information can only be viewed (or only used) by those people who must have a special permit);

4) The cryptographic protection of information both stored on the media, and in the process of its immediate processing (i.e. store and forward information only in an encrypted form);

5) Registration of all appeals to the protected information (maintenance of a special register).

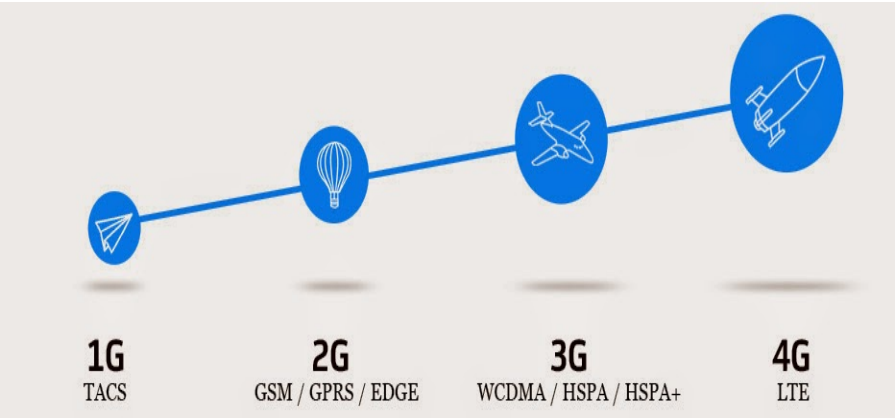
Thus, employees of companies must keep the question of information protection with the use of modern information technologies under control and work on their improvement constantly. This is the only possible way to reduce the risk of leakage of stored information.

Yaroslav Tkachenko
C.V. Sosnin, scientific supervisor
M.L. Isakova, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Evolution of mobile networks

It's hard to believe, but once the mobile phones really were called "phones", not smart phones, not superphones ... They enter your pocket and can make calls. That's all. No social networks, messaging, photo uploads. They cannot download a 5-megapixel photo to Flicker and Instagram, of course, cannot turn into a wireless access point. Of course, those gloomy days are already far behind, but promising wireless high-speed data networks of a new generation continue to appear around the world, and many things start to seem confused. What is "4G"? This is higher than 3G, but does that mean it's better? Why do all four US national operators suddenly call their 4G networks? The answers to these questions require a small excursion into the history of the development of wireless technologies.

It's worth starting with 1G. In general, the letter "G" means nothing other than Generation and denotes several communication standards that operate in a similar way. The first generation, from which everything started, was analog and did not even involve data transmission, focusing on voice calls. There was a network in the 80s and was represented by AMPS technologies in the US and a combination of NMT and TACS in Europe. Despite the fact that this generation became "mass" for mobile communication, the demand for it was extremely low. The reasons were high cost and terrible connection quality, which did not go into any comparison with the cable.



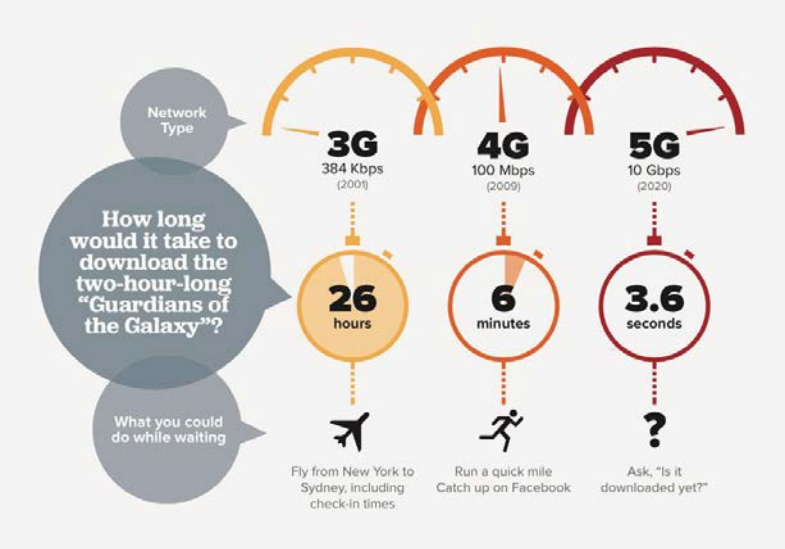
Technology 2G was the result of the digital boom of the 90s and allowed mobile communications to compete with the wired one. The US and Europe did not agree on the same technology and continued to develop in different directions. Americans promoted their own D-AMPS and early versions of CDMA, and in the Old World made a bet on GSM. The second generation of mobile communications began the era of full-fledged wireless data transmission. It all started with SMS and an amazing CSD format. This technology was the first to allow the transfer of digital data via a call. The speed of such a transaction reached 14 kBit / sec and no one then had a clue how to use it.

1997 was a turning point in the history of mobile communications. GPRS technology was introduced, which provided a continuous stream of data transfer and "made" the modem CDS. Speed theoretically could reach 100 kbit / s and allowed operators to rate traffic. GPRS appeared extremely timely - the craze for e-mail provided the new technology a huge popularity. Hypothetically, this innovation dragged on the third generation of communication. Otherwise, the International Telecommunication Union (ITU) decided, which in 1997 approved the IMT-2000 standard, now known as 3G. The key factor was the data transfer rate, which reached 2 MB / s. Thus, GPRS appeared between generations and received a stupid status of 2.5G. It is from this time that speed becomes the main factor and the driving force of change.

So what is 3G? This is a communication generation that combines three standards - FOMA, UMTS and CDMA2000. The first uses Japan, the other two in equal proportions are developing in the US and Europe, which have forgotten the habit of building different networks. UMTS is the standard that was created for the most simple transition from GSM and in fact is the next step in its evolution. But with CDMA2000 an interesting incident happened. With the fact that it was certified as 3G, the connection speed with difficulty overtook GPRS and was only 100 kbps (in the first generation).

The industry did not stop, and by 2010 it tightened the connection speed several times. The CDMA2000 network received an update to EV-DO REV.A, and UMTS - the HSDPA + protocol, which actually provides a speed of up to 42 MB / s, and is theoretically capable of overclocking up to 330 MB / s. As soon as these figures sounded, avid marketers decided to earn money and began to strengthen the idea of 4G, which should have included new standards. The main advantage of 4G should be a speed that exceeds the parameters of 3G by 200-500 times. In addition, unlike its predecessor, fourth-generation networks do not use a channel for voice transmission, but work only with digital data. This means that calls will go to the VoIP format and in the future may lead to the withering away of classical cellular communications in favor of Internet telephony.

The fourth generation of mobile communication is a new round of the Internet era. For the first time, wireless Internet can compete with fiber-optic networks, exceeding them in speed and availability. It is much easier to install one LTE base station than to weave a web of cables. 4G - a standard that will go beyond smartphones and is likely to replace the wired Internet in general. And after evolving into 5G.



We know very little about the fifth generation of communication. Its development is only underway, and implementation is expected by 2020. On what count? Most likely, 5G technologies will not find a global application. The speeds of 1 Gbit / s (and further and higher), which gives 4G, will be enough for use in domestic conditions. Coverage of the fifth generation will be used only in densely populated cities and in specific production areas. But this is only the future.

In conclusion, I would like to note that, as if in the future, wireless networks were not called, they still played and will play a key role in providing broadband Internet access in hard-to-reach areas. The operator is more profitable to build one 4G station, which will provide communication at a distance of tens of kilometers than to cover, for example, farmland with a web of fiber optic lines.

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Vlada Yakovleva
A. A. Martynenko, research supervisor
N. M. Nechai, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Influence of Cloud Computing on traditional hardware and software

The main features of modern information systems are flexibility and dynamics. Software-defined networks, storage systems – all of which aim to make information systems as adaptable as possible to the needs of the user, creating an elastic and optimal infrastructure.

However, the infrastructure is not needed by itself: it is deployed for the sake of applied solutions that bring real benefits to the company. Despite the flow of new technologies, the fundamental principles of constructing applied solutions have changed in recent decades. And now we are witnessing how new technologies in the infrastructure - cloud services - are beginning to change the approach of developers to the construction of information systems.

Cloud is an important innovation in the field of data storage, industry technologies and services around the world. This made it possible to freely exchange information between different applications and devices. The Internet can influence this process, because now instead of storing data on local servers or hard disks, you can store and access your data and programs through the global network.

The common definition of cloud service was adopted by the American National Institute of Standards and Technology. The service should have the following basic characteristics:

- On-demand self-service
- Universal access over the network
- Elasticity of services
- Consumption accounting

Technical directors and managers of large IT companies claim that 90% of the company's innovation and time is spent on software development, and the remaining 10% on hardware products using "cloud technologies."

Recently, cloud-based data storage applications such as Dropbox and Google Drive have received wide public support. Some people believe that a cloud storage (or storage) is just a data storage technology. However, it is not.

For example, for distance learning students of the National Mining University also used cloud computing - OneNet. The data uploaded by the teachers were available not only for downloading, but for editing and use. Cloud storage is also an innovative service. And it's not about storing data on the hard disk or about running programs.

Clouds for the first time allowed to solve the old and sick problem of scaling applications. A typical example of its appearance is as follows: suppose you create a service. In this service, you have built an architecture that allows you to easily scale it horizontally, for example, by adding application servers with load balancing. But how many servers do you actually need to deploy when starting the service? You decide that while there are not enough users, two are enough, and then, as the user base grows, you will add machines. You start the service, the first users come to you, everything goes fine. Two hours later, instead of the first hundred users, you are visited by a hundred thousand. And ninety-nine of them will see a time-out, or an internal error, or something else as unpleasant instead of a site with your service.

A naive alternative to this scenario is to think in advance of the maximum load and start the service on a hardware platform designed for it: for example, instead of two servers, 50 or 500. And all of them will eat up electricity and money 99% of the time, while waiting for that peak of visitors, which may not happen.

With the advent of cloud services, this problem can be easily solved. Your service should be scaled horizontally and allow you to monitor your download, and also to react to changing it. Then you can equip it with a simple logic like "if in the last 30 seconds the application servers are above the threshold – add another server; if in the last 2 minutes the application server load is below the threshold – remove one server."

The cloudy approach carries a few fundamentally new things that you need to learn to work with. As the system becomes networked, it can no longer be treated as local. The system is distributed, and there will be a variety of failures, "weirdness" in the network, for example, you can see a sudden lock or change files.

The principles of cloud computing are best used to solve Big Data problems. The cloud is optimally suited as an infrastructure basis for Big Data technologies. What is the essence of Big Data? The most useful and simple definition is data that cannot be processed by one compute node, no matter how powerful it may be. A typical example is the work of the Google search engine. The search engine at the user's request actually needs to "shred" all the Internet in one place. Hundreds of thousands of servers are working on this task: the processing of data is separated, after its completion the necessary information "runs" to the user in the form of search results.

It is worth noting that cloud computing not only carries a positive change. Cloud computing requires a constant connection to high-speed Internet. Disconnection from the network leads to a loss of data, and as a result, blocking access to information.

Thus, we can see how cloud computing has made software popular. The ability to store large amounts of data over the network simplifies the operation of hardware products, but also increases the requirements for network administrators and programmers.

Anastasia Yakunina
V.V. Slesarev, research supervisor
I.I. Zuyenok, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

System Analysis in the Problem of Vaccination in Ukraine

Nowadays vaccination is considered to be one of the greatest achievements in the global health. It is the most effective and affordable way to prevent various infectious diseases. Its obvious benefit is that a vaccine is much safer than the disease itself as the vaccine is intended to prevent the desease. Despite of the obvious advantages of active immunization, there has been a large-scale antivaccination campaign in Ukraine, the hot discussion raised by which is still going on. Experts say, that problems with vaccination in the country began because of the undermining of people's confidence in the vaccination and vaccines' quality. Raising awareness of the vaccines proposed to the Ukrainian inhabitants, their quality and effectiveness proved on practice, transparency of their use can be provided by system analysis.

System analysis is known as a scientific method of cognition, which is a sequence of actions made to establish structural links between variables and elements of the system under the study. It is based on a set of scientific, experimental, scientific, statistical, and mathematical methods.

Systems analysis usually deals with the future development. Consequently, the maximum interest represents any information about the future. For example: economic and political situations, resources, discoveries and inventions. For this reason, forecasting is the most important and complex part of the system analysis. That is why it can be applied in medicine and to the dynamics of vaccination, in particular.

The fall in the level of vaccination in Ukraine started in 2008. In 2013, the country had experienced the shortage of vaccines. Moreover, in 2016, the UN recorded a vaccination rate below 50%. in only eight countries of the world, among which was Ukraine which was at the same level as the Central African Republic, Chad, Equatorial Guinea, Nigeria, Somalia, South Sudan and Syria.

The Health Ministry points out that nowadays there is an outbreak of measles in Ukraine. For the first six months of last year, 735 Ukrainians got measles that is directly linked with low vaccination rates fixed in the Health Department report. Insufficient coverage of vaccination threatened the spread of infectious diseases, which were considered to be defeated in the civilized world, pointed out the head of the organization "Infectious control in Ukraine". The situation is rather problematic.

To overcome this situation systems analysis can be used. By using its methods, it is possible to evaluate the effectiveness of the vaccines and vaccination process, and make forecasts of the occurrence of certain infections that may contribute to their prevention.

Julia Zasipko
O. M. Galushko, research supervisor
V. V. Hubkina, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Multiservice Access Network for the Micro-district of the City Using WiMAX Technology

Practically every locality has Internet service providers, but the connection between them and the end user is not always possible. Therefore, it is advisable to use wireless technology of the WiMAX standard, which also transmits such various data as voice and video. For this reason, it is necessary to design wireless broadband access on the territory of residential array on the basis of WiMAX technology, in the presence of various reasons for the impossibility of connecting with the cable Internet.

Now, let us consider the opportunities of WiMAX network. WiMAX (Worldwide Interoperability for Microwave Access) is an international standard for wireless broadband 802.16. First of all, WiMAX networks are relatively simple and flexible in being deployed at fairly large distances without laying cables, as well as providing users with connections in units of Mbps. These networks are much cheaper for creating in comparison with GSM, use little power and can be powered by battery. Next, WiMAX can provide stability in conditions of direct visibility failure of the base station (BS) using the reflected signal. Also, it is economically effective as much as 1,5 times in terms of frequency resources consumption compared to its competitors and ensures simultaneous work of a large number of users without interfering.

Finally, WiMAX provides the possibility for users to access the Internet at a higher speed with much more coverage in comparison with Wi-Fi networks. To achieve such characteristics, a "backbone channels" technology with extension as dedicated lines, DSL, and local area networks is applied. This approach ultimately allows creating scalable high-speed network within the area. 802.16e standard includes using triple DES 3 encryption algorithm, where the encryption key length is much more standard. As a result, it will be extremely difficult to capture and use the data transmitted over the WiMAX channel.

MODELING THE NETWORK

Despite city conditions stipulated by such obstacles as buildings, trees and even weather, WiMAX is capable to transmit required data through a radio channel. It should be noted that the roof of tall buildings is the best place for BS location. The higher population density and more difficult propagation conditions, the smaller are cell size and, consequently, the coverage area.

To model communication networks, specialized software systems (e.g. "WiMAP-4G") are used, taking into account the recommendations of the chosen technology. The most important stage in designing broadband wireless access networks is the frequency-terrain planning process. The final network structure or

configuration and BS location are selected during this stage. The possibility to provide radio coverage with the given communication quality is identified and the frequency plan of radio channel distribution for the base stations is developed. This scheme is adapted to the conditions of the terrain and frequency constraints of the designed service area. Then service areas are formed for each base station and the network as a whole as well as internal system hindrances are assessed and minimized. During the planning process the possibility to provide required network capacity to monitor service load is determined.

The WiMAP-4G offers many parameters for calculating the budget of the line and, therefore, the most accurate result is guaranteed. Estimating field strength is the most widely used kind of calculation. Model for computing the field strength in the form of Erceg model for the type of terrain B is shown in Fig. 1. Terrain profile comprises such specific features as relief, antenna height, distance and interfering buildings located between the BS and the subscriber station (SS) and its line distribution to the selected client is shown in Fig. 2.

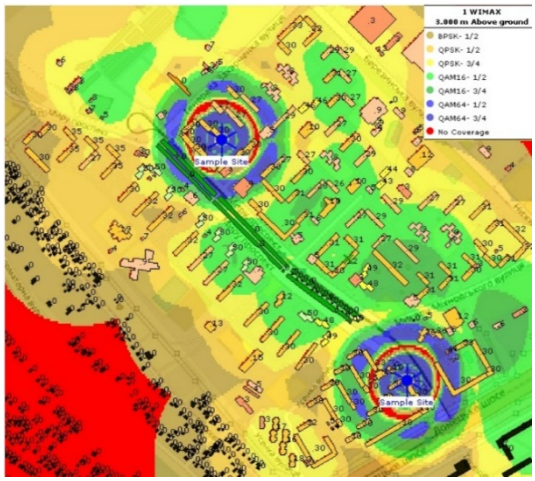

Fig. 1 – The result of field strength modeling

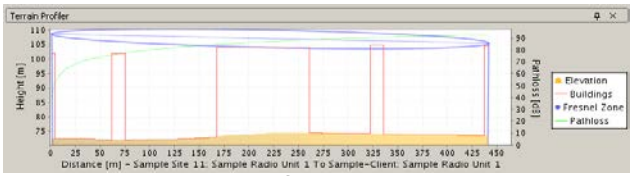

Fig. 2 – Profile terrain on line distribution

It should be concluded that due to this technology a great majority of users can get reliable access to the Internet service in the case of failure connection with the cable Internet.

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Ivan Zavorin, Misha Kuzmich
V.I. Meshkov, scientific supervisor
I.A. Ivanchenko, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Blocking of Internet Content

Nowadays, a lot of people all over the world are facing a kind of blocking when searching through the Internet. Access to Internet content in countries is blocked by the equipment of Internet providers. To the technical restriction of access, certain countries resort, as a rule, from considerations of national security and with a view of the implementation of specific law. Today, there are five countries applying the toughest rules, namely: China, Syria, Iran, Ethiopia and Uzbekistan.

Over the past few years, there has been a tendency to actively blocking quite legal resources. It also affected Ukraine last summer, when some of Russian resources such as VK, Yandex services, Mail.ru, Kinopoisk etc. were blocked.

The blocking of VK fell apart the social communication of youth.

At the same time blocking of Yandex services has also caused discord. People have lost what they have used for many years.

Today, the most usual types of content blocking are the following:

- IP and Protocol-based blocking;
- Deep Packet Inspection-based blocking;
- URL-based blocking;
- DNS-based blocking.

As a countermeasure there are ways to circumvent any listed type of blocking.

VPN is a virtual private network that extends a private network across a public network. Proxy, in computer networks,is a proxy server (a computer system or an application) that acts as an intermediary for requests from clients seeking resources from other servers. Tor is a free software for enabling anonymous communication Darknet. Benefits of blocking content:

- Citizens are protected from different types of illegal content.
- Children are protected from content that can harm their psyche

Limitations:

- Governments can use political and religious motives to block inoffensive content.
- Restriction of free access to information resources for users.
- Risk of incurring administrative and / or criminal liability.

To sum up, we can say that governmental control of internet content restricts our access to free information. On the other hand, it protects from dark side of Internet. So, internet blocking is a double-edged sword and we must find golden mean between it.

Anton Zhidkov
G.M. Saksonov, scientific supervisor
I. I. Zuyenok, language adviser
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Tips and Tricks on How to Deal with Malware

The increasing number of malware is one of the most burning problems in cybersecurity. Protection against malware is one of the principal prerequisites for safe computer operating and maintaining data confidentiality both for ordinary users and large corporations. There are myriads of different malicious programs which are ready to use any security vulnerability to obtain information and get unauthorized access to your device. This paper is focused on the varieties of effective strategies recommended to protect someone's computer from malware.

The history of malware starts from 1980's. Primitive viruses gradually turned into complex technological developments. The idea of a virus that injects other programs and computers has been transformed into a criminal business in 20 years. The definition 'malware' came from two words: malicious and software. There are a couple of synonyms to malware: computer contaminant and crimeware. Originally the creativity of scientists and researches reflected in the viruses have become a weapon in the hands of Internet criminals.

Nowadays there are a lot of different malicious programs. They varied from less dangerous the most of which could only annoy you to incredibly dangerous ones that could threat the national security of the entire country.

One of the most common types of malware is adware. Adware is the name given to the programs that are designed for display advertisement on your computer, redirect search requests to advertisement websites and collect information about you. One can notice that their search engine regularly displays ads for those products that you recently searched for in the Internet. This can be explained by the fact that adware gather marketing-type data about you.

The other common type of malware is Windows locker. This malware locks your Windows and requires payment for unlock. If anyone got the Windows locker, they shouldn't pay any money to swindlers in any case. Good news that most of lockers are outdated now. So, you can easily find instructions how to deal with it in the Internet. Other common types of malware are viruses, Trojans, backdoors, droppers, worms, exploits, rootkits and spyware etc.

Naturally, the question arises: how to protect your computer from all the mentioned above malware. Some tips and tricks checked on practice for protecting a PC are given below. The practice shows that following them anyone can reduce significantly the possibility of malicious software to penetrate in the devices and protect confidential information.

#1. Upgrade your software regularly.
#2. Install antivirus by choosing from their variety: Avast, Malwarebytes, Kaspersky, etc. To use their functionality at maximum, you must buy premium versions. Although, free versions are also enough for providing the basic protection. Some of antiviruses offers trial premium versions for free, take this chance to try it how it works.
#3. Don't click on the links within emails from unknown people and never reply them!
#4. Use a Firewall by choosing from those proposed by antiviruses offers or Windows default one.
#5. Backup all your personal data.
#6. Provide the security of your network by yourself. Don't broadcast an open Wi-Fi connection. Use WPA or WPA2 encryption because WEP in not good enough nowadays.
#7. Keep your personal information safe. Be aware that many hackers can use social engineering to get access to your social networks and data. They will search account to account to gain enough information about you to get unauthorized access to one of them.
#8. Use multiply strong passwords. Never use the same password on different accounts.

The experience proves that if to follow all the mentioned tips and tricks, there is a greater chance that you and your personal information will be safe from malware. So, theses strategies could be recommended to be used by all the PC users who wish to protect their information and keep it private and confidential.

Danil Zinkovsky, Hrihoriy Yershov
A.A. Martynenko, scientific supervisor
I.A. Ivanchenko, language advisor
National TU «Dnipro Polytechnic», Dnipro, Ukraine

Blockchain and Cryptocurrencies

Nowadays, crypto currency is incredibly popular. At large, it is similar to fiat money but with the difference that it is much safer, completely anonymous and transparent (you can easily track a transaction). Apart from that, crypto currency isn't susceptible to inflation, but currently it's very volatile. There are more than 1500 different kinds of cryptos, but the first and the most famous representative is Bitcoin.

The new approach is that this system uses distributed computation which provides absolute security. Due to that fact, bitcoin doesn't rely on a central server to process transactions or store funds.

Blockchain is meant to be used for decision making about state of transaction in the context of mutual suspicion. It's literally chain of blocks that include all of recent transactions. These blocks are designed in such a way that you can't change a block without changing hashes of the next blocks. There is only one true chain and it's the longest one and includes hashes that answer to some purposes which are difficult to accomplish. Put it simply, blockchain is something like an account book which contains every transaction ever executed in the currency. As it was told earlier, these books are shared by participants of the system. Due to that fact, it's impossible to hack this system because there are dozens of thousands computers all over the world that hacker must gain access to.

There are also network nodes (they're called "miners") that put together all of recent transactions into one block and confirm their validity. This process is called "mining" and it is similar to solution of a very difficult problem and the only way to solve it is an exhaustive search. Miners provide system with computation power and after solving they'll get crypto coins as remuneration for services.

It should be admitted that block chain is a very promising technology that integrates into different spheres of life such as banking or person identification.

Розширюючи обрії

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