

## **Philosophy of life - mechatronization**

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### **Mechatronization**

#### **Abstract**

The article deals with the concept of mechatronization, the problems of mechatronization were formulated. In the article the concept of the philosophy of mechatronization is introduced and general characteristics of mechatronization directions are given.

**Key words: mechatronization, mechatronics, holism, emergence, zenith, nadir, automation, cybernetics, synergetics, bionics, bionisation, reductionism, ideal space, sensitization, intellectualized movement, self-optimizing, semantic memory, machines with parallel kinematics, 3D printer**

#### **Introduction**

The 20<sup>th</sup> century was the century of cybernetics and automation. **Cybernetics**, as a science, introduced the term "feedback" into society as well as the general patterns of getting, storage, transformation and transmission of information in complex control systems. The direction of scientific and technological progress appeared side by side with it - automation. We can't probably say that these are two sisters of progress, rather, it is the mother and daughter. The use of the mathematical methods for modeling and self-regulatory technical means allowed automation reduce the degree of human participation in the operations people performed and the laboriousness of operations as much as possible. The term "automation" was widely used after Ford had established the department of automation in 1947.

The 21<sup>st</sup> century is the century of mechanization. Cybernetics and automation is the basis of it. The science for the development of a new direction of scientific and technical progress is mechatronics at the current stage, but its interaction with other sciences will be accompanied by a mutual penetration of some properties in others, as a result of it they will change each other in the context of mechatronization. It is a science and engineering based on the synergetic integration of nodes in precision mechanics (also "fine mechanics") with an electronic, electrotechnical and computer components.

Electrotechnical. This includes mechanical links, gears, motors, working body, additional electrotechnical elements, sensors. All components are used to provide

the necessary movements. Sensors have particular importance for the correct performance of targets. They collect the data on the status of the work object and external environment, directly mechatronic device and its components.

Electronic. This includes microelectronic devices, power transforms and measuring circuits.

Computer components. This includes microcontrollers and high-end electronic computers.

### **Formulation of the problem**

This article is devoted to a new stage in the development of mankind, from automation to mechatronization.

The task of the article is to show the relevance of the topic of mechatronization as direction of scientific and technical progress.

**The task of mechatronization** is the liberation of mankind from dependence of its habitat and preservation of this habitat. It is one of the main tasks of evolution.

### **Description of the research**

**Mechatronization** is an intellectualized movement of matter of time and space in an innumerable set of forms, objects and systems.

**Mechatronization** is the tool by means of which the humanities solve, and will be solving its basic task.

A person receives the first stage of independence from the environment from birth. Now the question is in the transition to the second stage of independence on the habitat - the dependence on the Earth, then the third stage of independence from the habitat - dependence on the Sun, then the fourth stage of independence from the habitat - dependence from the Galaxy and the last stage of independence from the habitat - fusion with the universe. On the second stage of independence we already remark how the quantity grows into quality and the basic philosophical postulate of mechatronization - the priority of the whole in relation to its parts.

**Philosophy of mechatronization** is holism. Holism - the relation of a part and a whole, proceeding from qualitative identity and the priority of the whole in relation to its parts.

The commonly used concept of synergy emanates from the holistic notions. The practical embodiment of the idea of holism is emergence (the notion appeared in synergetics) that means the appearance in the system of a new systemic quality, that irreducible to the sum of the qualities of the elements of the system.

A clear example of this is an anthill, where each insect is not particularly intelligent separately, but when there are a large number of ants, they can [solve](#)

[complex problems](#) to find food and protect from predators. In essence, the whole is greater than the sum of its parts.

Mechatronization includes automation, robotization, mechatronics and at the initial stage - bionics and other sciences of the future. Mechatronization gives way to the next stage of scientific and technical progress - bionisation. In its essence both of the stages of scientific and technical progress can't exist without intelligence for their development.

It was the century, the millennium of mechatronization and bionisation, the era of the new industrial and social development of society.

The mastering of the universe is at the zenith of mechatronization and the development of the ocean, the earth's crust, the mantle, and the earth's core is at the nadir of mechatronization. The nadir of mechatronization is such a complex direction as the zenith and in many ways it will help to develop the Universe at lower costs.

I'll start from the last stage of independence from the environment - a merger with the Universe.

It doesn't mean to be arriving at the final theory. The idea of final theory in the world of the infinity of space, matter, motion and as a consequence of these components – time is full of contradictions. We don't know the time limitation in past and future. If time is boundless, space is boundless too. The limitation of one kind or another immediately leads to the question: "What is there, beyond the limitation?"

The reductionism could help in developing the final theory if the Universe did not develop and did not perfect itself. The presuming of Steven Weinberg that our Universe is not the only one really desired, but then there is the problem of an ideal space between Universes.

As we can suppose, in ideal space there is no matter (neither light nor dark), there is no movement, which means that there is no time. Is it possible?!

Humanity aspires to understand the laws that our Universe is governed by at all times.

The basis of the Universe or the World is matter. Universal forms of the existence of matter in an infinite change of properties and forms are movement, space and time.

Philosophy defines: matter is uncreatable and indestructible, eternal in time and infinite in space, matter is the substantial basis of all possible properties and forms of motion.

The last stage of mechatronization does not presuppose the control of the Universe by humanity. It includes the independence of man from the environment – the Universe, the ability of a man with the help of highly intellectual mechatronic systems to save themselves in the ever-evolving and self-perfected Universe.

A question may arise: "Why is it from the last stage of mechatronization?" And the answer will be: "To see what stratum of technical perfection mankind needs to overcome".

In particular, unidentified flying objects (UFOs) is nothing else than a holographic image in the terrestrial atmosphere and that's why they move so easily and they cannot be caught up. The UFO itself is located at a sufficiently great distance from the Earth. When the source of waves moves at a distance of some millimeters, UFO will move to tens of thousands kilometers per second. Besides the UFO itself is one of the greatest achievement of the mechatronization.

Use in the mechanization of holography as a method of recording, reproduction and transformation, wave fields based on interference of waves, on registration of an interference pattern, which is formed by waves, reflected by an object, illuminated by a light source (object wave) will allow to expand the possibilities of information technologies, both in space and in the ocean.

Humanity go to its own UFO deliberately: micro drones, unmanned aerial systems much the same as UFO, the use of solar energy in aircraft with a large wingspan, then macrodrons, in shape resembling traditional UFOs, on the upper surface of which will be installed solar converters, and in the form of a plate of UFO. In the future we will not move anywhere from flying objects. In addition, this form will help to avoid catastrophes of flying machines and as result - natural victims.

If you look at the composition of unmanned aircraft systems, it can be seen that this is another achievement of mechanization and it includes: the drone flying apparatus, control station (operator's console, facsimile transceiver, specialized computers based on digital signal processors or computers running operating systems in the real time), communication system (this may be a direct radio or satellite connection).

The software is usually written in high-level languages, such as C, C++, Modula-2.

Just mechatronization is the basis of all these innovations. Specialized editions often refer to the term "Industry 4.0". As many specialists consider, the possibility of exchanging data of mechatronic systems between each other, the possibility of system manufacturer to monitor the Internet through the implementation of rules for the operation of systems consumers and to anticipate violations, will fundamentally change the traditional industrial production.

The mechatronization of production will radically change the traditional logic of production, as far as each working object will determine itself what kind of work is necessary to perform for production.

Mechatronic systems require their high degree of sensation that is creation of highly sensitive multifunctional sensors. Sensors of various types, such as pressure and temperature sensors, electro-optical and infrared sensors, will function together creating a general picture of what is happening and determining what is happening in their environment.

A large number of sensors will register its encirclement with incredible accuracy, and the built-in processors will integrate various personal data from sensors for identification of complex events and critical conditions and their interpretation on the basis of the current situation and they will take decisions independently, regardless of the central system of production\_control based on given results.

In mechatronization mechatronic modules based on MEMS technology are used widely. Typical measured parameters mechatronic modules of MEMS technology include movement, speed and acceleration (linear or angular), acting forces and moments. Examples of sensors based on MEMS technology can be accelerometers – acceleration sensors.

MEMS-are technologies that allowed creating intelligent sensors, where the measuring functions of the current parameters of the mechanical motion, their transformation and processing by the given algorithm were united in a single block.

The intellectualization of sensors makes it possible to achieve higher accuracy of measurement, providing filtering of noise, calibration, linearization of input/ output characteristics, compensation for hysteresis, cross links.

Devices for 3D printing by themselves are the achievement of mechatronization. Knowing of the general principles of how a 3D printer works, allows us to talk about the large consumer potential of these devices. Theoretically, with the help of such equipment we can adjust non-waste production. At this stage, its capabilities are evaluated mainly by specialists who use 3D printing in solving their professional tasks.

The program language in printers at this stage is the G-code, built on the commands of printing equipment management. At this stage, you can go to the program slicers, which provide translation of 3D-model for 3D printing in a clear code for controllers. The main tasks of the program slicers are to set the parameters in accordance with which the printing will be carried out. Program selection is determined by the type of printer.

The presence of the ability of mechatronic systems to interact with their environment, plan and adapt their own behavior according to surrounding conditions, learn new models and lines of conduct, and on the basis of active **semantic memory**, respectively, be self-optimizing will allow mechatronization to link the virtual space of the Internet with the real world. These capabilities will ensure the effective release of even the minimum lots with rapid application changes in the output and a large number of options, will contribute to the future environmentally safe production.

By and large, mechatronization is the best choice of the scientific, technical, technological, organizational and economic and informational solutions with the intellectualization of movements. Ensuring the work with obstacles, in reconfigurable systems, when you want to copy the configuration of the circuit in non-deterministic external environments – fires, floods, space, underwater, underground, radioactive and other using mostly non-linear bases of executive movements in the direction of mechatronization.

The intellectualization of movement of mechatronic systems, functioning in a changing and uncertain external environments, require automatic monitoring and diagnostics its state, adaptation and optimization of features in terms of the external environment changing, when there are significant perturbing influences, significant autonomy and flexibility in planning and the performance of movements with minimal human participation.

Only mechatronization can solve questions of the characteristic features of the nonlinearity of basic executive motions of systems of movement. Questions of anisotropy and heterogeneity of dynamic, elastic and speed properties, variability of parameters in nonlinear equations can lead to loss of system controllability in singular positions, complexity of assignments of manipulator movements in generalized coordinates, related to degrees of mobility, performance for spatial along the curvilinear trajectories of movement and realizations of complex laws in time.

Mechatronization allows to create universal machines for many degrees of freedom movement with parallel kinematics.

The modern tendency of constructing machines of a new generation, which consists of the transferring of the functional load from mechanical components to the intellectual (electronic, computer and information) components and can be reprogrammed easily for a new task comes from the holistic notions in mechatronization. Now mechanical devices are increasingly becoming bottleneck in complex machines. The mechatronic approach is not a complement, but a

substitution of functions, traditionally performed by mechanical elements of the system in electronic and computer blocks.

The method of electronic reduction also provides with the redistribution of functional load in the direction of increasing the intellectual component, when the executive mechanism monitors the motion of the master device.

Taking into account the increase in the intellectual component, we should keep in mind that the objective functions, tasks of the upper and lower levels of management usually harmonize poorly. This forces us to introduce appropriate adjustments to objective functions of the lower level, without destroying the orderliness of distributed system.

Therefore, one of the functions of the upper-level system should exert an appropriate influence on the lower-level systems that would allow to provide a state in which the mutual interaction between them would be desirable.

The problem of describing of the motion of a multidimensional mechatronic system in mechatronization is divided into two interrelated subtasks: movement in space and time.

The laws of the spatial movement of all links in the mechatronic system are determined by the technological formulation of the problem of motion.

The laws of motion in time of actuators are determined, on the one hand, by desired law of displacement of the working organ, and, on the other hand, kinematics of the multidimensional system.

It does not matter that there is such a physical phenomenon in the Universe as "black holes ", it is important what task the Universe sets before the "black holes", one of its working bodies is in improving itself.

It does not matter that there is a UFO, it is important that if we go in the opposite direction of mechatronization philosophy - holism, then we come to a particular, namely, to a rational being and the question arises: "Where is he from?"

This digression was made in order to convince the readers of the need to study the basics of mechatronics, which will unite many sciences and technical achievements together.

The main principle of mechatronization is the concept of a device for configurable control (control configured vehicle-CCV) ACU-configuration, in which maneuverability is a priority function.

The inhomogeneity of the characteristics (kinematic, velocity, dynamic, elastic) of environment, anisotropy (application of the force vector in a given direction), in which the mechatronic systems work, requires solving of the control task in space and time.

In the case of the apparatus of configurable control, there is a mechanical instability that often turns out to be necessary to ensure the corresponding dynamic characteristics. Stability is achieved thanks to the presence of control loops.

What is being said about the "fourth industrial revolution", in reality is the development of mechanization. Research organizations and the industrial sector are working hard to make Industry 4.0 in a reality.

In The German Research Center for Artificial Intelligence (DFKI) in Kaiserslautern, the first smart production in world has been used for several years as a "live" laboratory. This production is the reference architecture for Industry 4.0 in mechatronization.

An important factor for success of mechanization is the intellectual interpretation of information about the environment. Accordingly, the software plays a main role here.

The feature of software lies in its large inefficiency. With the accumulation of information that needs to be processed, the difficulties associated with the creation of software arise. If a certain volume is exceeded, even unsuccessful circumstances can happen, for the solution of which in most cases it is desirable to use hierarchical structures of software.

But, nevertheless, the choice of decentralization allows to increase the intellectual component of mechatronic systems due to computer distribution, reduce the amount of information transmitted in the system, simplify physical schemes, and one communication channel can be used repeatedly.

This provision is embodied in the fact that as programming languages began to use structural languages, unified descriptive languages and Internet as a communication platform in the enterprise. Another direction of development was the distribution of software in the functional blocks.

In fact, mechatronization cannot exist without the intellectualization of motion. Modules of motion, mechatronic modules - are a transitional stage of mechatronics, a stage where the new is still weak, and the old hard-relay control system did not want to give up. It is impossible to imagine mechatronization without intellectualization of movement. This is the future.

## **Conclusion**

During the study, the necessity of the introduction of the definition "mechatronization" in the terminology of technical progress is proved.

Even if once the teleportation is confirmed, it will easily be mastered in mechatronization as mechatronic technology of intellectual movement.

Why don't we talk about the academic discipline "Fundamentals of Mechatronization" ?

## **New Paradigm - mechatronization**

### **Abstract**

A new paradigm of the current stage of science and technology and mankind as a whole development is proposed, which arose on the basis of a new set of concepts, mechatronization. The scientific and technical concepts that determine the specific research and development and combined by this paradigm are considered.

**Keywords: paradigm, mechatronization, myology, neurology, bionics, sensor-soul, osteology, syndesmology, neurobionics, nanotechnologies, nanotubes**

### **Introduction**

At the end of the 20th century and at the beginning of the 21st century, a transition to the information society takes place, accompanied by the avalanche-like growth of accumulated information, and its depreciation for 4-5 years, in this connection, it is necessary to react to changes in a mobile way.

The more information a person receives about the objects surrounding him, the more he reveals their essence, gets the opportunity to influence them purposefully. The level of development of society therefore largely depends on the volume of accumulated information, how it is stored, processed and transferred.

The new scientific and technical concept of informatization of the society based on information technologies with the use of computers in its importance can be compared only with the most outstanding technical discoveries in the history of mankind; their application allowed to increase the processing speed of information in millions of times. A personal computer made these possibilities accessible literally for every person.

The dialectics of the development of system is such that in the process of accumulating information, scientific and technical achievements are revealed that are not invested in the existing paradigm and a new one is required.

Even more the Internet moved to this, the possibility of communicating among themselves in the most remote corners of the Earth, conducting production management at a distance, the possibility of closer communication of people with psychophysical deviations with the world, with themselves, for example, deaf-mutes.

The following scientific and technical concept is important as well - satellite and mobile communication, which clearly traces the fundamental results of science, embodied in technology and become a powerful accelerator of production.

Many other concepts that will be considered in the research give us a set of concepts that can be combined under the name of a new paradigm - mechatronics.

### **Formulation of the problem**

The task of the study is to show that humanity from the cult of force (through the power of machines, the acceleration of various transitions in the production process) through human rights freely implement their ideas passes to the cult of reason (changing the constructive principles of machines, providing a new system quality, transferring the functional load from mechanical nodes to intellectual ones - electronic, computer and information components, intellectualization of movement, development of bio-drives).

### **Description of the research**

A new concept in the field of information storage - the transition from analog formats to digital formats. Especially this need has affected the satellite communications, where there is a significant removal of the receiver from the transmitter, limiting the power. Satellite communication is poorly suited for transmitting an analog signal. Therefore, the signal, for the purpose of providing noise immunity, is digitized, special transmitting antennas and error correction

systems are used. It should be noted that many countries have turned from analogue television broadcasting to digital television.

A new scientific and technical concept is holography and holographic television. A method for re-recording a holographic image has been found, and thus a holographic image device is just around the corner. The screen can be vertical or horizontal, and Old Khottabych will go for a walk right on the coffee table in the house of TV viewers. Why we recall Khottabych, because the best children's films will have to be rewritten in a holographic image, which naturally will require the research and the development of a new equipment.

The development of holographic television will allow the sky to be used as a screen and even can be as colored, will glow with all the colors of the rainbow. There will be a holographic industry, new industries, to have time to jump up, at least on the footboard of an electric vehicle.

A new scientific and technical concept is electric vehicles. Ecological, first of all, as well as economic problems caused mankind to return to electric cars at the beginning of the XXI century. By this time, the batteries have become more perfect. So in 2010, on one battery charge, the electric car Daihatsu drove 1000 kilometers, while the electric car Ventura developed a maximum speed of 515 km/h. The process of improving batteries and the mechatronic systems of electric vehicles will increase the possibility of introducing electric vehicles. The resort cities completely rebuild the maintenance service for the operation of electric vehicles. The ecological and economic effect will be significant.

A new concept is nanoscience. A nanoscale archive memory is developed that is capable of storing high-density data for a long time. The design of this memory is based on carbon nanotubes and crystalline iron nanoparticles, which under the influence of low voltage can move and the final position of the nanoparticle is fixed and read by a simple measurement of the resistance.

Nanotubes are used in radio equipment, mechanical vibrations of nanotube allow you to hear radio signals. Radio nanotubes at the expense of small sizes are used in radio-controlled devices of rather small sizes to exist in human blood.

The application of nanotechnology allows to execute the direct conversion of the light flux into motion. For example, the use of optothermal heating leads to the appearance of gradients of the surface tension of the liquid, as a result, an object made of vertically coupled nanotubes embedded in plastic effectively absorbs

the light and converts it into heat. When the object is heated asymmetrically, a driving force is generated by the object over the surface of the liquid.

To clean the walls of blood vessels from cholesterol deposits, absolutely microscopic engines (the size of a molecule) are needed. The ZETTTL group was able to create a nanoengine - mechatronic module, using multiple layers of carbon nanotubes. The nanoengine is a rotating metal plate on which a carbon nanotube is fixed.

Low external stresses with high accuracy control the speed of work and the position of the rotor-plate. This is a high level of mechatronization.

Now we are starting to consider the next scientific and technical concept, the main for a new paradigm is artificial intelligence (AI).

The most common approach assumes that AI will be able to exhibit behavior that is not different from human behavior, and in normal situations. This idea is a generalization of the approach of the Turing test, which asserts that the machine will become reasonable when it is able to maintain a conversation with an ordinary person, and he will not be able to understand that he is talking to the machine (the conversation is by correspondence).

The science of AI has evolved from the origin of the foundations of mathematical theory of computation - the theory of algorithms, when the first computers were created, a prehybrid approach that assumes that only the synergistic combination of neural and symbolic models achieves a full range of cognitive and computational possibilities.

For example, the expert rules of inference can be generated by neural networks, and generating rules are obtained through statistical training. Supporters of this approach believe that hybrid information systems will be much stronger than the sum of different concepts separately.

It was proposed the creation of artificial intelligence systems based on the modeling of reasoning, where the theoretical basis is logic, through an agent-oriented approach, developed since the early 1990s, based on the use of intelligent (rational) agents.

According to this approach, the intellect is a computational part (roughly speaking, planning) of the ability to achieve the goals, set for the intellectual machine. The machine itself will be an intelligent agent, perceiving the surrounding world with

the help of sensors, and capable of influencing objects in the environment with the help of actuators.

This approach focuses on those methods and algorithms which will help the intellectual agent survive in the environment in the performance of its task. So, here algorithms of path search and decision making are studied much more carefully.

A logical approach can be illustrated by the use for this purpose of the language and the logical programming system Prolog. Programs written in the Prolog language represent sets of facts and rules of logical inference without rigidly setting of the algorithm as a sequence of actions leading to the desired result.

Artificial intelligence is developing. The problem of machine learning deals with the process of independent acquisition of knowledge by an intelligent system in the process of its work. This direction was central from the very beginning of the development of AI.

In the middle of the 20<sup>th</sup> century Ray Solomonoff outlined a report on a probabilistic machine that is taught without a teacher. Supporters of this approach believe that the phenomena of human behavior, its ability to learn and adapt is the consequence of the biological structure and the peculiarities of its functioning. This approach differs from the understanding of artificial intelligence by John McCarthy when they proceed from the premise that artificial systems are not required to repeat in their structure and functioning the structure and processes occurring in it inherent in biological systems.

The next scientific and technical concept is robotics. In 1962, the first industrial robots "Versatran" and "Unimate" were launched in the USA, some of which still function, having overcome the threshold of 100,000 hours of work resource.

If in these early systems the ratio of costs for electronics and mechanics was 75% to 25%, then at present it has changed. The final cost of electronics continues to decline steadily. The appearance of inexpensive microprocessor control systems in the 1970s, which replaced specialized robot control blocks for programmable controllers, contributed to a reduction in the cost of robots by about three times. This served as an incentive for their mass distribution in all branches of industrial production. The most important classes of robots of wide use are **manipulation** and **mobile** robots.

**Robotic manipulator**-automatic machine (stationary or mobile) consisting of an actuator in a manipulator having several degrees of mobility, and a program

control device that serves to perform motor and control functions in the production process.

**A mobile robot** is an automatic machine in which there is a moving chassis with automatically controlled drives. Such robots can be wheeled, stepping crawlers. There are also crawling, floating and flying mobile robotic systems.

The control of robotic systems is being improved. The complex of tasks connected with the adaptation of robot to the circle of problems solved by it, programming of movements, synthesis of the control system and its software is being solved.

The next scientific and technical concept is military technology. A bright representative of mechatronic systems is the plane Su-47 "Berkut" with a forward-swept wing which gives the impression of a futuristic machine that flies in defiance of the laws of physics. Of course, all this seems only at first glance. An unconventional wing model warms up interest in the aircraft. Specialists and pilots admire for its maneuverability.

Russia is one of a few countries brought the idea of reverse sweep of the wing to a logical conclusion. This work was laborious, costly for the budget, but all the proceedings made sense. Perhaps, for this reason, the Su-47 "Berkut" is a source of pride for designers and military men, and repeatedly performs as an adornment for aviation shows. The plane received advanced avionics. The Su-47 "Berkut" is close to the characteristics of the project "Stels". The technology of the Russian fighter also allows you to remain unnoticed by radar.

Another interesting mechatronic system is the armored car "Karatel"(The Punisher). The machine is designed to transport soldiers of special forces, and fighters are placed back to back in the landing compartment, which provides them with all-around view and the ability to fire through loopholes.

In addition, the machine is equipped with a system of six video cameras, which allow you to assess the environment in difficult weather conditions and at night. Armor "Karatel" corresponds to the sixth class. The suspension and bottom of the machine are protected from mine threat.

The design of doors is original enough: each of them consists of the top and bottom doors. In this case, the lower leaf performs the functions of the footboard during the landing. Certain issues are caused by the design of the front part of the armored car with large windows located at an extremely acute angle, it is convenient for the driver to look at the road with a good viewing angle.

The next scientific and technical concept is microelectromechanical systems (MEMS). They are characterized by two signs. The first is the size, the second is the presence of moving parts and the destination for mechanical actions. In the world they are known under the abbreviation MEMS - MicroElectroMechanicalSystems.

They connect the technological breakthrough with microsystems that humanity will make in the 21<sup>st</sup> century, they are predicted to make the same revolution that microelectronics performed in the 20th century.

Microtechnologies develop on the basis of scientific and technological reserve of microelectronics. At the same time, microelectromechanical systems are called upon to actively interact with the environment. In addition, the design of systems have a distinct three-dimensionality.

From classical mechanical systems, they are distinguished by their size - materials on this scale behave somewhat differently than in bulk, although microsystems still obey the laws of classical physics, in contrast to nanosystems. Nevertheless, classical physics predicts special properties for micro-devices. All this requires a number of completely new approaches to the design, fabrication and materials of MEMS.

New tasks in design are associated with the need to calculate and simulate not only the problems of circuit engineering and logic, but also a set of problems of solid mechanics, thermoelasticity, gas and hydrodynamics - separately or simultaneously appearing in the product. As for materials, despite the fact that monocrystalline silicon - the traditional material of microelectronics - has a number of unique properties, other materials are needed with new combinations of electro-physical-mechanical properties.

New tasks of technology are associated with the most characteristic differences of microsystems from microelectronics products: if the latter are essentially two-dimensional and mechanically static, then microsystems are real three-dimensional structures whose elements must have the possibility of relative mechanical movement. These new properties require the development of new technological operations for 3-D shaping.

As MEMS develop at the junction of a multitude of branches of science and technology, it requires the participation in the work of specialists from the most diverse areas of knowledge that could effectively interact.

During the transition to the second stage of independence from the environment - dependence on the Earth, a person will be interested in the person himself, his device in terms of creating an industrial analogue.

Bionisation as a new concept of mechatronization will allow creating mechatronic systems based on bio-drives (these are not only muscular drives) - drives using the achievements of osteology, syndesmology, myology and neurology (neurobiology), that is, creating bionics.

Bionicist - industrial analogue of man. Think - not a robot, not a slave, but an industrial analogue of a person with artificial intelligence based on neurobionics. Its difference from a person will be in the absence of a genotype, and the most undesirable - it will not have a natural (and for someone - divine) sensor - the soul, but you can say that life can procreate itself.

**The basic law of mechatronization is the most effective movement with minimal energy expenditure.**

The simplest example is if an architect has developed paths for the movement of people to an object, and people follow a different path to an object, which means that the architect does not know the basic law of mechatronization. People save their energy. To do this, the architect must calculate the movement of the flow of people and make the right logistic decision, ensuring the efficiency of the movement.

Many modern systems are mechatronic or use elements of mechatronics; therefore, mechatronics gradually becomes a “science of everything”, and the process of the society’s coverage of this science, industry, production, its penetration into other sciences is called mechatronization. Mechatronization encompasses everything and everyone.

## **Conclusion**

As a result of studies of the totality of new scientific and technical concepts, defining concrete research and development, it can be concluded that they should be united under a new paradigm, namely under the common name – mechatronization, it is necessary to dare to recognize the new paradigm.

The old paradigm - automation, fulfilled its purpose at certain stage in the development of society, but there is one important factor in it - automation of inefficiency - inefficient, mechatronicization eliminates this factor.

**The basic law of mechatronization is set forth - the most efficient movement with minimum energy expenditure.**

**The development of mechatronization - artificial intelligence, drives and power sources**

### **Abstract**

This article focuses on **the dual task of mechatronization**, the need for early understanding of the significance of mechatronization, the beauty of mechatronization. The issues of degree of mechatronization are considered, in conjunction with the level of development of artificial intelligence, the problems of development of mechatronization are specially noted, the concept of development of mechatronization is introduced.

**Keywords:** mechatronization, **the degree of mechatronization, mechatro-drives**, the development of mechatronization, artificial intelligence (AI), artificial intelligence system (AIS), artificial intelligence space, artificial superintelligence (ASI), super energy sources.

### **Introduction**

In the absence of understanding the new direction of scientific and technical progress - mechatronization, in the absence of understanding the basic dual purpose of mechatronization - the liberation of humanity from dependence on its habitat and the preservation of this habitat, people have achieved tremendous "success" in the destruction of natural resources, in the pollution of environment of the planet, climate change and the devastation of non-renewable natural resources.

The Earth is a mechatronic system in the overall complex mechatronic Solar system and it has its own sophisticated super drives, which combine both the drive and the operating device, such as the ebb and flow of huge water masses when the position of the Moon changes.

The reprogramming of the Earth: the construction of high-rise buildings, the creation of new lakes, canals, water reservoirs, deforestation, controlled by a mechatronic Solar system that scans the surface and through its drives – the operating devices, trying to change the situation. And no matter how ridiculous and unreal it looks, the Earth responds with earthquakes, tsunamis and floods, abnormal heat and cold.

The Earth seems to be conducting a process of purifying and restoring its strength, natural reserves and solar energy. Negative thoughts, emotions, negative energy of a person, hate, cruelty, violence are also reflected in nature and the planet reacts and responds to the actions. The process of updating is constantly being carried out by the planet. The planet warns and changes the consciousness of people through its information field.

A man and mankind, as highly advanced mechatronic systems as a whole and each separately, based on the philosophy of mechatronization, must urgently find a common language with the planet Earth in the performance of the dual task of mechatronization.

### **Formulation of the problem**

This article is devoted to the development of mechatronization.

The objective of the article is to show, based on the study of concepts and the study of changes in constructive principles, that the degree of mechatronization will be determined by the level of development of artificial intelligence.

The rates of mechatronization, the development of mechatronization technologies and, as a consequence, the development of society are constantly increasing. Proceeding from the tasks of mechatronization - the liberation of humanity from dependence in relation to its habitat and the preservation of this habitat, artificial intelligence (AI) is of particular interest today. In 1956 John McCarthy introduced the term "artificial intelligence" and the first launch of an artificial intelligence program was made at Carnegie Mellon University.

### **Description of the research**

Artificial intelligence is not magic or science fiction, but a fusion of methods of science, technology and mathematics.

Artificial intelligence with perfect drives and an operating device forms an artificial intelligence system (AIS). Autonomous actions of artificial intelligence systems, especially so-called counter autonomous actions (when an artificial intelligence system that has undergone testing learns, draws conclusions from what happened and chooses the solution itself how to withstand the tests) make the artificial intelligence system more intelligent and increase its capabilities. And

each time artificial intelligence in the composition of these systems is being transformed into artificial superintelligence (ASI).

But it immediately raises the question of how AI-systems should behave today and in the future. They should help a person to make better decisions faster or to allow a person to be excluded from the sphere of decision making.

The experience of mastering cyberspace suggests that success is achieved due to the speed of information processing. In this regard, a person becomes a weak and slow link in the decision-making chain and, accordingly, there will always be a temptation to create a completely autonomous system and over time a fully intellectualized system based on artificial intelligence community – an autonomous artificial intelligence space.

In conjunction with the perfect (advanced by himself) motion drives and the possibility in their artificial intelligence space to have their super source of energy, society will receive an element of development with the highest degree of mechatronization.

It is important that contact with the AI will not be lost. It is impossible to deprive it of drives, it is not in the interests of man, the AI must be improved, i.e. it needs to provide movement or move itself — the basis of mechatronization.

The study of concepts shows that the **degree of mechatronization** will depend not on **the level of functional microelectronics**, but on the level of development of artificial intelligence.

Presumably, there are the following main categories of artificial intelligence:

- **Limited artificial intelligence** (ANI, Artificial Narrow Intelligence). It is artificial intelligence specializing in one particular area.

So far artificial intelligence can solve only individual problems: for example, playing a game of chess, recognizing a speech, finding an image or drawing it. It can ensure the functioning of smart homes, analyzing the preferences of residents, adjusting environmental factors to the usual and comfortable (temperature, lighting, maintaining humidity level, noise reduction, etc.). Making changes to the program leads to a change in its structure. Modification is not quick and easy.

Systems of narrow artificial intelligence pose no threat to humans. In the worst case, a failure in such a system can cause local concern such as a power surge.

The transition from limited artificial intelligence to general artificial intelligence is very complex: skills that seem simple to humans, because they have developed

over millions of years of evolution, are complex for artificial intelligence. When you kick with a foot to hit the ball, your muscles, ligaments, bones and eyes perform a whole series of operations that are consistent with the goal.

Computers should have the same thinking abilities as a person. One way to achieve this is to increase the number of operations per second.

- **General artificial intelligence** (AGI, Artificial General Intelligence). Such AI is a computer whose intellect resembles a human, that is, it can perform all the same tasks as a person: substantiate, plan, solve problems, think abstractly, compare complex ideas, learn quickly, use accumulated experience.

In mechatronization, artificial general intelligence technologies are widely used as a part of intelligent robots, which play an important role in the rehabilitation of patients with various injuries and diseases. Communicating with artificial intelligence - voice assistant through gadgets, photo editing apps, we carry out its in-depth training.

The emergence of a double neuro-module, which has provided gadgets with new intelligent functions that control power consumption, connection to networks, security and other components of the operating system, allows them to understand for themselves what tasks they need to spend a large amount of power and in what cases to save energy and reduce the energy consumption of source. For example, the smart function of clock frequency adjustment allows you to instantly improve the performance of graphics module. The speed of image recognition has doubled, compared with the previous generation of processors - from 6 to 12 seconds.

A program with artificial intelligence can absorb new modifications, sorting highly independent pieces of information into one. Therefore, it is possible to change pieces of information from the program without affecting the structure of the program itself. The modification is quick and easy.

The improvement of general artificial intelligence and its transformation into artificial superintelligence goes in two directions:

- Scientists are working on the so-called reverse engineering of the human brain. This work will be completed by 2030, and we will learn all the secrets of our brain. An example of such a system is an artificial neural network.
- Imitation of human brain functions. In the course of this experiment, it is planned to divide the brain into many subtlest layers and scan each of them. Then using a special program, it will be necessary to create a 3D model, and then embed it in a powerful computer. After that, we will get a device that will

officially have all the functions of the human brain. All that remains for us to do is to collect information and learn.

- **Artificial Superintelligence (ASI).** A superintelligence is a phenomenon that we can't even partially understand. In our view, an intelligent person has an IQ of 130, while a stupid person has less than 85, and an artificial intelligence will have, approximately, an IQ of 12952.

The development of artificial intelligence and the development of mechatronization will complement each other, the development of one will push the development of the other.

**The development of mechatronization is understood as the improvement of drives and operating devices, energy sources and their synchronization with the development of artificial intelligence.**

In the course of the development and improvement of mechatronization, and linking its development with the development of artificial intelligence, mechatronization problems arise through artificial intelligence, which as the development progresses it will be necessary for the community to solve. They are:

- control over artificial intelligence systems;
- protection against hacker attacks;
- decision making in an emergency;
- mistakes and responsibility for mistakes of artificial intelligence system;
- ways to synchronize artificial intelligence systems.

Based on the fact that mechatronization is an intellectualized movement, the movement of the operating device which takes many forms, people will be forced to improve **motion drives**, and taking into account the basic law of mechatronization (the most efficient movement with a minimum expenditure of energy), as well to improve **energy sources**.

It is possible to control the amount of energy and, if necessary, limit the amount of energy with a certain condition of obedience to AI up to a certain point in the development of artificial intelligence.

### **Energy sources**

Modern li-ion batteries are very reliable and safe, capable of withstanding a large number of charge and discharge cycles. They have a minimal memory effect and a

relatively low weight. Due to such properties, li-ion batteries are widely used in many devices.

They can be used as rechargeable batteries, in the form of batteries for household appliances, as well as a highly efficient traction source of electric power. Nowadays such devices have several disadvantages: high cost; do not like deep discharges; may refuse at low temperatures; lose capacity when they get overheated.

As more advanced analogs, you can use lithium polymer or lithium - titanate batteries with a large number of charge - discharge cycles. They have a minimal memory effect and a relatively low weight, a high capacity and a high voltage.

A powerful accelerator of mechatronization development is the successful development of the peaceful atom energy. People relatively recently managed to successfully direct it for themselves. The main quality of radiation technologies is universality, the possibility of application in almost all areas of development and areas of human existence.

Now, when a man faces the question of transition to the second stage of independence from the environment - dependence on the Earth, and then the third stage - independence from the environment - dependence on the Sun, the peaceful atom opens up unlimited possibilities. Radiation properties are incredible. With the help of radiation, you can create a space engine capable of carrying the space research apparatus to the planets and other celestial bodies of the Solar System, and, in the future, to the distant stars in our Milky Way, solve the riddles of human civilization and even preserve the fragile life on planet Earth.

Inspection and control systems of airports, railway stations, subways, stadiums and, in general, places of mass gathering of people are based on the properties of X-rays (already known to us), capable of seeing hidden elements.

Contactless scanning systems, based on radiation technologies, are permitted by the World Health Organization as completely safe, including for children and animals.

MagRay baggage scanning technology, based on a combination of radiography and nuclear magnetic resonance, has been developed. The technique makes it possible to distinguish hazardous substances from safe ones and eliminates the need to remove a laptop or phone from baggage, St. Petersburg Scientific-Technical Center RATEC has developed a baggage screening system in which thermal neutrons help determine the chemical composition of an object. So you can detect explosives,

poisons and drugs without opening the suitcase. The screen displays not a picture, but a table with information on the content of chemicals in the inspected object.

The energy of peaceful atom is the best helper in space.

Without the use of radiation technologies, it is impossible to imagine the existing and future world space programs. Back in Soviet times, the compact nuclear power installations “Buk” and “Topaz” provided power supply for the onboard space equipment of various spacecrafts.

The heat generated by radioactive decay has also been applied. The Soviet "Lunokhods" during their travel on the natural satellite of the Earth were heated precisely by a radioisotope heat source based on the isotope polonium-210.

NASA Curiosity Mars Rover is equipped with a nuclear battery that retains heat inside the device and provides it with energy for movement. A neutron generator is also installed on it, created by Rosatom specialists. This device confirmed the presence of water on Mars.

The principle of operation of the equipment is based on the irradiation of the surface with a stream of neutrons, emitted by a neutron generator. And the reflected (so-called secondary) radiation from the object is captured by the detector. The resulting data is then processed by a computer.

The heat released as a result of radioactive decay can also be converted into electrical energy. Thus, the famous RTGs (radioisotope thermoelectric generators) appeared – stable and durable sources of electric power, capable of operating in conditions of space cold and high radiation fields of giant planets.

American spacecraft Pioneer-10 and Pioneer-11, Voyager-1 and Voyager-2, Galileo, Ulysses, Cassini, as well as descendable probes of the first and second "Vikings" were equipped with a radioisotope "heart"- RTG, based on plutonium-238 radionuclide. These unique devices have completed the most important tasks in the study of the Solar System. Some of them still work. For example, today Voyager-1 has reached the limits of the Solar System and continues to function reliably. This is the first spacecraft in the history of mankind, which transmitted signals from interstellar space.

The mastery of outer space is one of the main tasks of mechatronization. Obviously, in the study of deep space, those places where starlight can no longer be used to produce electricity with photocells, radioisotope energy sources will become indispensable.

The world community is working on the creation of a fusion power plant. Humanity will get a cheap, very reliable and almost endless **super source of energy**.

### **Nanotechnology charger**

Nanotechnology will play a significant role in the development of mechatronization.

Nanotechnology will allow to create a new source of energy – "nanogenerator". The technology is based on the use of a piezoelectric material that generates electricity while in a state of mechanical stress. The material is endowed with nanoscopic pores, which turn it into a flexible sponge.

Such a "nanogenerator" works like a sponge, it only absorbs kinetic energy from the environment and sends it directly to the smartphone, the dashboard of each car. In addition, the technology has the potential to be used on a larger scale, for example, in industrial equipment.

### **Mechatronics**

At this stage of development of mechatronization, humanity cannot create drives of a cosmic level, which ensure the ebb and flow of the Earth, the rotation of the Earth around its axis and around the Sun. It could only provide flights of satellites, mechatronic systems, in a geocentric orbit and other orbits with orbit correction from time to time, but the pace of development of mechatronization allows us to conclude that space drives are not far away.

Nanotechnologies make a significant contribution to the improvement of mechatronics.

Nanobots – robots created from nanomaterials, which are comparable in size to the molecule, with the functions of movement, processing and transmission of information, execution of programs. Nanobots are replicators capable of making their own copies.

Currently, there are already electromechanical nanodevices capable of having a movement, which can be considered prototypes of nanorobots.

Molecular rotors are synthetic nanoscale engines capable of generating torque when a sufficient amount of energy is applied to them.

The use of mechatronic drives, multifunctional sensors with high static, dynamic and frequency characteristics, the values of input and output signals allowed mechatronic systems to significantly press traditional means of automation. The

main advantages of mechatronic systems include: relatively low cost due to the high degree of integration, unification and standardization of all elements and interfaces; high quality of implementation of complex and accurate movements due to the application of intelligent control methods; high reliability, durability and noise immunity; constructive compactness of modules right up to miniaturization.

Specialists in the field of mechatronization are constantly working on the creation of a wide variety of actuators controlled by artificial intelligence based on effects and phenomena known in nature.

In recent years, actuators based on piezoelectric transducers (PET) have become widespread in mechatronization.

In this class of actuators, as an electromechanical transducer, piezoelectric ceramics are used, which are able to deform when the electric potential changes (the mode of reverse piezoelectric effect) and can also generate electric potential on their surfaces when deformed by an external force (the mode of direct piezoelectric effect).

Unlike traditional electromagnetic converters, which are based on the change of the electromagnetic field, an electric field is used in PET, which significantly increases the reliability and noise immunity of the actuators under external perturbing electromagnetic fields.

## **Conclusion**

As a result of studies of the totality of new scientific and technical concepts, defining specific research and development, it can be concluded that the development of mechatronization, **the degree of mechatronization** will be comprehensively associated with the use of artificial intelligence.

**The degree of mechanization is related to the level of development of artificial intelligence used in the mechatronic system.**

Drives and energy sources will correspond to the intelligence of this degree of mechatronization.

Three degrees of mechatronization are proposed:

- 1) Limited – ANI - mechatronization;
- 2) General – AGI - mechatronization;
- 3) Super – ASI - mechatronization

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