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Accepted October 26, 2019

## Artificial Intelligence in Mechatronic Systems: Problems of Embodiment\*

### Abstract

The article deals with the issues related to the possibility and limitations of technological creation of artificial systems endowed with consciousness and acting subject existing in the world of artificial subjective reality. The problems of creating an artificial personality in the given parameters are shown. The main obstacle to the creation of intelligent systems is the lack of progress in our understanding of the nature and mechanisms of the brain in the process of generating mental image and organization of purposeful activities. The transfer of psychology data to the engineering sphere is ineffective due to the difference in conceptual and instrumental areas of these disciplines. The approaches of synthetic psychology and pedagogy designed to provide a solution to the problem of creating an artificial subjective reality and techno-genic modification of man are presented.

**Keywords:** artificial subjective reality, artificial consciousness, artificial senses, synthetic psychology, self-organization, convergent and divergent technologies

**Acknowledgments:** The work was carried out in the framework of the state task of the Ministry of education and science of the Russian Federation No. 25.8444.2017/БЧ.

For citation:

Sergeev S. F. Artificial Intelligence in Mechatronic Systems: Problems of Embodiment, *Mekhatronika, Avtomatizatsiya, Upravlenie*, 2020, vol. 21, no. 2, pp. 93—101.

УДК 004.8

DOI: 10.17587/mau.21.93-101

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## Искусственный разум в мехатронных системах: проблемы воплощения\*

Рассматриваются вопросы, связанные с возможностью и ограничениями технологического создания искусственных систем, наделенных сознанием и действующим субъектом, существующим в мире искусственной субъективной реальности. Показаны проблемы создания искусственной личности в заданных параметрах. Основным препятствием к созданию разумных систем является отсутствие прогресса в нашем понимании природы и механизмов работы головного мозга в процессе порождения психического образа и организации целенаправленной деятельности. Перенос данных психологии в инженерную сферу малоэффективен в силу различия понятийных и инструментальных областей данных дисциплин. Представлены подходы синтетической психологии и педагогики, призванные обеспечить решение проблемы создания искусственной субъективной реальности и техногенной модификации человека.

**Ключевые слова:** искусственная субъективная реальность, искусственное сознание, искусственные органы чувств, синтетическая психология, самоорганизация, конвергентные и дивергентные технологии

### Introduction

The dominant themes of the defining part of the scientific and technological discourse of modern engineering knowledge of the last decade and, in particular, robotics, one way or another, are connected with the problem of the human factor and the problem of creating complex technical systems endowed with artificial intelligence in their capa-

bilities identical or superior to the human mind. In the case of robotics, we are talking not only about intelligent, but also about intelligently operating in social systems and communications artificial machines and mechanisms. At the same time, the categories of "intelligence" and "mind" are often considered synonymous by the engineering and technical community, despite the deep, repeatedly noted in the Humanities, fundamental differences in their content and conceptual structure [1, 2]. The sources of humanity's aspiration to the world of "intelligent machines" are the General dissatisfaction of

\*Работа выполнена в рамках государственного задания Минобрнауки РФ № 25.8444.2017/БЧ.

man with himself and attempts to find a replacement for him in the complex technological world, which imposes special requirements on man, far exceeding his physical, psychophysiological and mental capabilities. Along with the development of technologies and means of communication, the process of human integration with the emerging intellectual techno-genic environment of the planetary scale is observed [3, 4].

The problem of symbiosis of man with the man-made world created by him becomes especially relevant when we talk about the expansion of the human mind into new environments of experience, manifested, inter alia, in the exploration of outer space, macro — and micro-worlds of the physical world, in aggressive and harmful to human forms and conditions of activity. Questions of interaction between man and technology inevitably arise in the creation of complex systems and managed complexes. For example, in the study and colonization of the planets of the solar system and the exploration of deep space, the problems of interaction in space robotics, management of automated technical systems and technologies serving planetary bases and production require their solution. The problems of the unity of man and technology in the harsh conditions of space are becoming particularly complex and relevant.

The solution to the problem of "man in the techno-genic world" is seen by most scientists and engineers only in the technological aspect and is reduced to the creation of artificial intelligence superior to human capabilities. At the same time, technology is seen as a catalyst for progress, as a friendly environment that enhances the capabilities of mankind, as a compass and a guide for development. This is a rather dangerous point of view, removing control over technological development. Forgotten are the warnings of Cybernetics founder Norbert Wiener, who believed that "excessive fascination with technology can seriously damage the environment, which we will learn soon enough or never know-we will no longer be." Excessive faith in science and optimism create and maintain among the population and part of the scientific and technical workers faith in the limitless possibilities of mankind, enjoying the fruits of man-made civilization [5]. We are convinced that there are practically no spheres of human activity where the achievements of techno-science forming convergent complexes of NBICS technologies and their variants uniting interdisciplinary fields of humanitarian and technical knowledge are used [6, 7]. Civilization is moving to the point of technological singularity, in which technological progress will become inaccessible to our understanding and will be carried out by artificial intelligence, which in turn will be integrated with techno-modified man through computer and neurocomputer interfaces and virtual environments [8, 9].

In the future go to the past as a biological species becomes technobiod. The evolution of the man-made environment of human civilization of planet

Earth, its penetration into all levels of society, the human body and psyche is global in nature, accompanied by organized increase in the level of inter-system integration, the incarnation on Wednesday, intelligence, and friendliness to man, emerging technobiotic unity. The expansion of life, leading to the emergence of a complex symbiosis of man and the environment created by him through technology, can be considered as the next stage in the development of the noosphere, generating a planetary self-organizing unity — technobiod. Its influence on man and humanity differs from the opinion widespread in modern humanitarian and sociological discourse about the self-organizing action of autopoietic communication, which constitutes and determines the observed forms of human society. Technobiod is an evolving system, building its own individual history, but it is not the history of society and man, and techno-biological symbionts. At the same time, models operating with ideal ideas about the social evolution of human civilization cease to work, in which the leading role is played by individual scientific and collective creative abilities of a person, generating an environment that has the properties of the noosphere of V. I. Vernadsky. Technobiod becomes an independent self-organizing system object, generating forms of symbiotic and artificial intelligence and their hybrids, in which the once leading role of the individual human mind gradually fades into the background. Separating from the biosphere, man becomes an intelligent element of the evolving techno-genic world, in which individual behavior and human activity lose their decisive importance for the processes of technobiod development. Man becomes an element of a new planetary system unity regulated by the mechanisms of self-organization, which includes in its development active-reflexive processes of Assembly and evolution of systems of different nature. Previously unknown techno-social catalytic forms are formed, which dramatically accelerate the emergence of new and utilization of old system objects of organized complexity. Processes of generation of the active self-organizing environment of activity of mankind are observed. The initial phases of the development of a new technobiotic civilization can be associated with the phenomenon of multi-environmental self-organization, leading to the points of singularity. They violated all previously existing laws, and assumptions about the future are unknown and uncertain. Everything makes no sense. And even a scientific understanding of what is happening also has no significance for the emergence of a new quality of a complex organization [10].

For the first time the term "singularity" in a technological context was used by Stanislaw Ulam in an obituary dedicated to the memory of John von Neumann. It describes a conversation with von Neumann about "the constantly accelerating progress of technology and changes in human life that lead to

the approach of a significant singularity in historical development, beyond which human activity in the forms known to us will not be able to continue" [11]. The current stage of development of human civilization, at first glance, confirms this hypothesis. Previously inaccessible technologies and products have appeared, reflecting our knowledge of the nature of things in a wide range of space, energy and time. These are nano- and biotechnologies, Internet, cellular communication, robotic systems, and artificial intelligence technologies. They reflect the progress and opportunities for the synthesis of science and technology. One gets the impression of unlimited possibilities of technogenic civilization. However, this is not entirely true. Despite the considerable efforts of the scientific community, using the most advanced devices and equipment, no one has managed to understand the sources of human development and civilization, and, explain, the determining role in them of the moral and spiritual foundations of the world around us. There is a certain rejection of technology and science from man, which become independent entities, devoid of any form of social control. This is quite dangerous because of the possible uncontrolled development of situations leading eventually to the destruction of humanity.

The public consciousness is dominated by forms of technocratic thinking and intelligence. The thesis of their superiority over their social and biological forms is supported. According to V. P. Zinchenko, "Technocratic thinking is a worldview, the essential features of which are the primacy of the means over the goal, the private goal over the meaning and universal interests, the symbol over the being and realities of the modern world, technology (including psychotechnics) over man and his values. Technocratic thinking is Reason, which is alien to Reason and Wisdom. For technocratic thinking there are no categories of morality, conscience, human experience and dignity. An essential feature of technocratic thinking is the view of a person as a trainable, programmable component of the system, as an object of a wide variety of manipulations, and not as a person, which is characterized not only by self-activity, but also freedom in relation to the possible space of activities" [12].

Our worldview has changed dramatically over the past decades of technological development. The world is no longer as mechanistic, predictable and simple as it was represented in our minds in the models of the classical natural Sciences. It is complex and diverse, with probability and chance, quantum entanglement and nonlocality, dark energy and matter, and models and technologies that change our understanding of the nature of time and space.

Attempts to use all these achievements of natural science are ineffective in studying the phenomena of the human soul and psyche. An experiment, even if it is a thought experiment or a fact of self-observation, instantly changes a person's psychic reality. His

consciousness becomes different. The phenomena given to us directly in sensory experience stubbornly defy experimental investigation. We do not know the methods and technologies that allow us to study directly the content and basic mechanisms of the human psyche, its subjective sphere. Attempts to study the functions and structure of the brain give rather modest results and in practical terms are suitable only in medicine for the diagnosis of pathological conditions of the body. Despite technological progress, we are still far from understanding the work of the human psyche and the mechanisms of its implementation. This state of the psychological Sciences hinders progress in the technological implementation of artificial intelligence and intelligence.

The main problem in the scientific study of mental content is due, apparently, its holistic, integral nature. Because of this, the basic tools of science based on analysis, observation and measurement do not work well in psychology. Also, modeling and experimental methods, well-proven in the natural Sciences, are ineffective. The scientific analysis of the psychic and the consequent reduction of the content destroy the synthetic properties of the living, transforming it in its models and relations into a collection of complex, hierarchically connected, but dead and lifeless elements and structures. Disappears mentioned above the whole system-defined notion of "soul". This gave rise to the famous domestic psychologist V. P. Zinchenko generate Maxim that "psychology sacrificed his soul for the sake of objectivity of its subjective science" [13]. Psychologists do not deny the existence of the soul, but refrain from studying it, giving the palm in this matter to religion. Because of this, the main achievements of psychology are associated with the study of only behavioral characteristics of a person, indirectly indicating the work of his psyche. This is not enough to solve the problem of creating artificial human analogues.

It should also be noted that theoretical psychology is increasingly losing its psychological content, giving the baton to the currently fashionable cognitive psychology, which uses cybernetic and information metaphors and approaches in the study of human physiological reactions to stimulus material. Hypotheses about physiological determinants of the brain determining the forms of mental reflection of reality are exploited [14, 15]. A complex of disciplines, calling themselves cognitive Sciences, is actively developing, based on the ideas of cognitive neuroscience, which has absorbed all the illusions, errors and expectations of physiological psychology, the technological continuation of which they are. The use of new technologies of computer analysis of neurophysiological indicators of the active brain and methods of visualization of the results in fact do not change anything in our knowledge of the psyche compared to the results obtained in the last century on simpler experimental facilities.

Gentleman's set of modern researcher of the human brain and psyche includes computed tomography, multi-channel electroencephalography, magnetic resonance imaging, magneto encephalography and transcranial magnetic stimulation. With their help, a huge amount of experimental data is obtained, the free interpretation of which is the essence of neuroscience. It allows us to describe in a new language any known facts of human behavior, but does not explain their essence. The models created within the framework of new technologies are very far in their essence from the object of psychology research — a person acting in the world, transforming and cognizing the world and nature. They do not solve the main problem of consciousness—the problem of qualia, which consists in explaining the qualitative subjective experiences experienced by a person in various mental States [16]. Despite the huge amount of experimental material accumulated in neuroscience, the nature and forms of connections arising in the physiological structure of the brain with the qualia of subjective reality are still insufficiently studied. The real person deals with the psychic reality including the subjective world and the subject operating in it in the form of the personality experiencing in the multimodal form the whole spectrum of internal and external sensory, mental and sensual phenomena, living the difficult social and personal life, showing human qualities, showing phenomena of creativity, tops of human spirit. All this has been studied so far on a descriptive level, beyond the explanation of their essence and connection with the physical world that generates them.

For the sake of justice it is necessary to recognize that thanks to development of natural Sciences and psychology many secrets of the live nature inaccessible to our direct perception and common sense are solved. We already know a lot about the structure of the human body, its biology and physiology, psyche. However, we know almost nothing about the soul. Here the achievements of science are quite modest. According to V. P. Zinchenko, "no one has ever managed to uncover the mechanism of the miraculous, to attack the absolute (not only in the field of psychology)... the soul cannot be reduced to knowledge, feeling and will. The soul is a mysterious excess of knowledge, feeling and will, without which their full development is impossible" [13, p. 4]. Psychology, using the methods of the natural Sciences, has learned in its constructs and models to dissect the living psychic whole into parts, but the reverse synthesis of them into a whole is still inaccessible to us. The main problems of the human "I", consciousness, creative and cognitive capabilities of man, his creative activity, goal-setting in activity, permeating the entire pyramid of psychological knowledge, without which it is difficult to talk about the creation of artificial intelligence, remain unresolved.

## **Problems of techno-modification of human psyche and creation of systems with artificial intelligence**

The creation of human-like intelligent technical systems and robots, their inclusion in the social life of mankind, involves serious changes in the social and personal life of man and society, causing problems of a moral nature without the solution of which it would be rash to talk about the emergence of these systems. Endowing them with the properties of a reflective system that generates an artificial "I" can cause social conflicts and the struggle of artificial systems with man, which nourishes the authors of science fiction literature and cinema.

The philosophical reflection of the consequences of technological intervention in the processes of biological and social evolution of man is reflected in the ideas of transhumanism, which is an intellectual and cultural movement, a system of views that support the use of new data of science and technology to increase the cognitive and physical abilities of man. An advanced radical version of transhumanism is presented in the concept of posthumanism [17].

The concept of "transhumanism" was created by the founder of UNESCO biologist Julian Huxley (Julian Huxley) in his essay "Transhumanism", published in the collection "New bottles for new wine" (1957). He from positions of global evolutionism considered possible technological self-improvement of the person. "The human race," according to Huxley, "can, if it wants to, surpass itself, and do it not only sporadically: someone in one thing, someone in something quite different, but quite differently, on the scale of humanity as a whole. We need to give a name to this new belief. Perhaps, the word transhumanism will fit here: a person will remain a person, but will surpass himself, realizing the new possibilities of his own nature" [18, p. 17].

The first problem of transhumanism is related to its philosophical basis. Transhumanism as a radical form of materialistic worldview reflects excessive technocratic optimism, supported mainly by representatives of engineering and natural science knowledge and quite easily refers to deep psychological phenomena. Its adherents consider it possible to copy the mind with the help of a technological procedure that allows you to transfer the ideal content of the living brain to other, not only biological, carriers. This form of philosophical reflection is reflected in the form of vulgar total cognitivism, whose proponents consider the phenomena of mind and psyche to be purely informational processes, and man to be a computer algorithmic biological system.

Theoretically, transhumanism is essentially a new concept of human evolution in modern conditions. The transhuman is declared to be a transitional type, as a new being that has arisen thanks to modern advances in science and technology. Transhumans do not have to be future-oriented or the most tech-

nologically savvy people, nor do they have to be aware of their "connecting role in evolution." They have signs of self-identification and active personality, have improved body implants, asexual, reproduce artificially, have a distributed personality [19].

One of the unsolved problems of transhumanism is related to the self-organizing nature of the living, which prevents the management of these processes from the outside. Because of this, the actions associated with the construction of the living are technological intervention in processes that have internal logic and mechanisms of existence. As a result, the basic structures that determine the work of the mechanisms of life can be damaged.

Criticism of transhumanism is mainly concerned with emerging ethical and moral issues in relation to "failed products of technomodification". First of all, it concerns genetic engineering, which contradicts the "will of God" and "violates the natural order of nature" [20]. According to E. V. Vvedenskaya — "transhumanists clearly dominate the belief in the incredible prospects of technical improvement of mankind and there is no critical analysis of the negative consequences of this, taking into account the existential risks that undermine the foundations of existence, as an individual and human society" [20, p. 39]. "Radical genetic modification of the biological nature of man, according to the expectations of transhumanists, is only a stage in the further development of human autoevolution, when the synthesis of man and machine will have to be realized, by introducing artificial implants and chips into the body and brain. Man, according to transhumanists, goes into the past as a biovid and goes into the future as a technovid. The world of pathological artificiality kills all living things in man, he constructs himself, determines his physical quality. In the consciousness of the post-man, the boundary between the real and the artificial is dismantled, not only his corporeality disappears, but also the true individual "I" [ibid.].

From the point of view of bioethics, "the main contradiction in transhumanism is the denial of moral perfection of man and the reduction of his essence only to the improvement of somatic and cognitive characteristics" [ibid.]. Close arguments about the violation of the boundaries of the human Self and the disappearance of the subject in the process of technomodification of the body and brain are present in E. V. Mareva — "If nanotechnology and imitation of living tissue make it possible to replace the human brain, will the person retain his individuality, personality? After all, why would I want the immortality of my body if it wasn't me? If personality is a derivative of bodily organization, we lose it by changing the body. If the personality is a derivative of communication with similar, not only contemporaries, but also ancestors through the world of culture, it is possible to assume that other existence will affect spiritual well-being, but it will be my self-consciousness

and well-being by means of the "repaired" brain as means, but not essence of my I" [21, p. 173].

According to A. I. Crimina "you can often find synonymous understanding of transhumanism and post-humanism. Although these philosophies work with modern constructs and use similar terminology, their interpretations are fundamentally different. The discourse of transhumanism refers to the Cartesian juxtaposition of soul and body. Despite the sacralisation of the technological and the purification of the Posthuman from such seemingly permanent attributes of the living as aging and death, transhumanism largely continues the ideas of the Enlightenment. In the understanding of posthumanists, the subject is nomadic and represents an Assembly of the human, animal, digital, chimerical. Thus violated the main Maxim of humanism about man as the highest value-man in posthumanism ceases to be "the measure of all things" [17]. Posthumanism leads to the idea of the Posthuman and considers the equality of man, nature and society as co-evolving self-organizing entities.

At the same time, a number of scientists consider human techno-evolution inevitable and find a solution to this problem in strengthening the humanitarian component of technological knowledge. According to V. I. Arshinov and A. L. Andreev, "if we consider engineering activities in relation to the prospects for the development of techno-science and sociotechnical design, it is quite natural that the question of a significant expansion of engineering competence due to the enrichment of its social knowledge may arise. For it is social science that is called upon to clarify and bring to the consciousness of man the values, motives and images that are implicitly laid in the basis of various programs, projects and directions of techno-science, as well as to model future "social worlds" that will arise during the evolution of the techno-sphere created by the activity of mankind" [22].

Our rather limited knowledge of the human soul is accompanied by the currently observed major technological breakthrough in the natural Sciences and convergent technologies and their applications. And this is quite dangerous, because it causes the technocratic part of humanity to replace the natural evolution of man with technological intervention in his body and nature. "Scalpel" is already created, but who and how will use it? For many people, the answer seems obvious — it's robotic systems and "smart" technologies of the future, superior to the natural intelligence of man and his imperfect mind. Only they will allow overcoming a barrier of technological complexity of arising tasks. But unfortunately, we are not ready for a radical but well-considered action. The development of the techno-genic environment of modern civilization is accompanied by the emergence of the problem of increasing its complexity, intelligence, intellectuality. Special forms of intelligence are required, different from the natural human

intelligence, which arose and focused on solving the problems of human biological survival. We do not know the technology to obtain them. The progress observed in the last decade in the technologies of information transmission and processing, unfortunately, also does not automatically lead to the emergence of appropriate quality and efficiency of intelligent software tools, still working on deterministic algorithms of situational control.

The use of machine learning technologies, which are currently developing intensively, is considered by many experts as the beginning of a genuine intellectualization of the world of machines. However, the fundamental limitation of this technology is the inability of the machine to independently choose a training algorithm, since an infinite number of regularities can be obtained from a finite set of data. Among them will be algorithms with which the machine will cope badly. This forces us to turn to the study of the mechanisms of self-organization of experience in learning technical systems, leading to the possible quasi-social development of systems with artificial consciousness and cognitive development of the world, but what will be the result of machine socialization is unclear to us. Perhaps it will be a machine repetition of human history, in which there is no place for man.

The question of creating systems with artificial consciousness becomes relevant in the problem of the "smart world", replacing the problem of artificial intelligence, experiencing a conceptual crisis. The fact is that the limitations of the intelligence of an algorithmically functioning artificial system are related to the limitations of its Creator, reducing his experience into an algorithm. A system with artificial consciousness can potentially form a subject-actor capable of self-learning and assimilation of social experience of various communities available to him through language and behavior more effective than a person. However, we cannot say what kind of personality will be formed in the process of social and personal self-organization, and what goals it will set for itself? Having free will, it can consider a person an extra link and take appropriate measures.

Most of all, from an engineering point of view, it would be possible to copy the information about the personality of a living person, preferably wise professional and social experience and implement it into a technical system that creates conditions for the maintenance and continuation of the process of mental self-organization ensuring the existence of a self-organizing self, which is equivalent to the transfer of the soul to other carriers. However, everything is not as simple as, for example, in a cybernetic system, the program of which does not depend on the computer implementing it. A digital copy of a computer program is absolutely no different from the original, which allows you to copy it in unlimited quantities. The mental content of a person is unique,

due to its continuously evolving depending on the conditions of life psychophysiological structure and self in the form of an acting subject. This leads to the fundamental impossibility of simultaneous and complete fixation of the state of all structures and processes of the brain involved in the creation and maintenance of the mental. The solution of this problem at the present stage of development of science and technology is difficult, according to some authors, almost insoluble problem. In the process of measuring some States of the structure of the brain, other parts of it will pass into a new state, as a result of which the continuity of the process of mental regulation will disappear. There can be no reflective subject, which determines the further direction of development and form of the mental process. Hypothetically, it can be assumed that a working model of the mental process will be created with a permissible error, in which all the basic properties of the original are preserved. However, we do not know with what accuracy the real brain functions, supporting the mental content of a particular person, and how stable it is when changing the physical parameters of the brain. Indirect observations indicate the existence of a wide range of stable mental processes that preserve the "I" of a person, ensuring his self-identification even with fairly extensive brain lesions after serious diseases and even clinical death [23]. However, no one has been able to find a direct physical connection between the phenomena of subjective reality and the neurodynamic systems of the brain, although it is the hypothesis of the presence of communication is the basis of almost all information models of the brain. In the center of attention of researchers there are two main questions of "difficult problem": if to phenomena of subjective reality it is impossible to attribute physical properties — weight, energy, spatial characteristics — how to explain 1) their communication with brain processes and 2) their causal action on corporal processes. These questions within the framework of the information concept of consciousness are investigated by Professor D. I. Dubrovsky. He introduced two initial assumptions:

1) Information must be embodied in its material, physical carrier (i.e. does not exist outside and in addition to it);

2) Information is invariant with respect to the physical properties of its carrier (one and the same information can be embodied and transmitted by different physical properties of carriers [16], the principle of information causality Introduced by the author is designed and allows to circumvent the physical limitations of information carriers forming the content of the human psyche.

To substantiate the information approach, D. I. Dubrovsky hypothesized the existence of neurodynamic codes that determine the existence of qualia. Every qualia is necessarily embodied in its neural code, does not exist outside and in addition to it [24].

Modern models of the mental view it as the result of the brain, which is a biological computer, included in multiple relationships with physical reality, presented in consciousness as a virtual subjective reality. The problem of the subject as an active participant in the life process, carrying out its activities in the context of interaction with the objective world is the most difficult to understand and implement in terms of technology. The possibility of creating an ego-system with a subject acting in it can be attributed to poorly studied both theoretically and practically. Much says that it is a form of information self-organization arising in the phenomenal field of consciousness.

It is possible to assume possibility of realization and work of the following mechanism of generation of the artificial subject environment (the world of reality of the artificial subject) on the basis of two-stage model of reducing consciousness (Sergeev S. F., Sergeeva A. S., 2016) [25]. In accordance with it, the perceptual systems of the artificial organism at the first stage of its development continuously carry out the process of reduction of the stream of distinctions coming from the physical world, turning it into a finite set of interacting autopoietic variants of the States of the inner world, accompanied by the appearance of the reflecting subject and his subjective reality. At the same time the condition of consistent existence of the physical process generating them is observed. There are internal and external forms of the closed cyclic process of transformations of external in internal and internal in external. It can be assumed that an artificial system with similar properties is quite possible to implement technically in the form of a hybrid cyber-biological form implementing the principle of re-entry (Edelman J.) [26] and the postulates of the theory of information synthesis (Ivanitsky A. M.) [27]. According to them, the brain maintains a continuous recursive cyclic process of parallel multidimensional comparison of signals coming to the brain from the brain and the external environment. In cyclic repetition of operations of comparison of input and output signals of system the reaction of the arising subject to the external world is reflected also. The inner form of the world of the artificial subject is analogous to, but not identical with, the subjective world of man. The difference is that the vital needs of the living organism, which form the activity and motivational spheres, are embodied in the human subject and his world. The organism itself creates a subjective reality for its needs. Subjective history forms occur in the life process of a subject, his experience is determined by selective engagement of a dynamic information system of the brain, bounding the infinite or a very large variety of possible, which is the subject automatically options world. The selected variants exist in the subject's implicit memory as a cloud of possibilities in a potential, timeless form. Each of the variants can be actualized, constructed and reproduced

in the form of a time sequence of the current reality of the subject (in its subjective time and subjective form), reflecting the actual state of the subject in consciousness. In the memory of the subject is stored not all the experience, but only the markers that trigger the standard independent biological generators that make up the network structure that implements the picture of the world and the subject. It should be noted that functional independence, standard behavior and topological organization of generators contribute to maintaining the spatial-temporal and modal integrity and stability of the subjective picture of the world.

Consciousness in accordance with the logic of its functioning chooses from the existing in the subconscious reduced set of possible options for the development of the individual world the most necessary and close at the moment option, which is implemented and used to ensure the self-preservation of the organism and writing the history of the world and the life of the subject. Thus, there is a two-stage process of forming the image of physical reality. At the first stage, a base of options is created that do not contradict the conditions of existence of the autopoietic process of consciousness and the observed world (the experience of the subject), and at the second — one of its options is realized, reproduced in a conscious form.

Note that not all States of the physical world can be used in the elements of autopoietic self-organization of consciousness. Manifests the selective nature of the psyche. At the second stage of reduction there is an organization of available autopoietically consistent variants of development of history of the subject. They are reflected in consciousness in the phenomena of the thinking subject. It should be noted that the subject evaluates not only the options of his fate, but also chooses acceptable options according to the criteria reflected in his personal organization, which arises under the influence of social orientations created by social mechanisms of self-organization.

The given model focuses on the important role of the need-motivational sphere of a person creating conditions for the emergence of a reflective subject and its development in the process of life. How to provide such mechanisms in an artificial system is not entirely clear? A reflective artificial conscious system can function only through self-learning in the context of its interaction with social or learning systems. In this case, an artificial personality is formed, playing the role of an active agent that determines conscious behavior and cognitive activity. The introduction of moral codes created by humanity can be destructive for the psyche of the artificial subject, which will lose important for the reflexive system meanings of self-preservation, organizing and supporting the life of the subject.

According to Thomas Metzinger, the human Ego and its subjective reality are complex representational phenomena developed as a result of evolu-

tion, the result of a process of automatic dynamic multilevel self-organization. Ultimately, subjective experience is a biological data format, a highly specific way in which information about the world is presented as our knowledge. But there is no such thing as the Ego in the world. The biological organism as Such is not the Ego. It is only a form of the content of representations—namely, the content of the transparent Self-model activated in the brain of the organism [28]. Despite the apparent paradox of Metzinger's hypothesis, it should be noted that it is supported by a significant number of studies and experiments demonstrating the formation and transformation of the subjective picture of the world [29, 30 and 31]. In particular, they show the role of synchronization between multisensory perceptual signals with the observed form of bodily self-consciousness, developing in childhood and manifested in a sense of presence in the world.

Metzinger's research provides a fundamental opportunity for the creation and existence of systems with artificial subjective reality on non-biological media, which raises a number of problems of a technological and ethical nature, which can be solved only by the methods of future techno-Humanities, which can be conditionally called synthetic pedagogy and psychology [32]. These are scientific and practical disciplines that will inevitably arise and will study the processes of learning, self-learning and socialization in artificial, aware of their existence in the world systems with artificial or hybrid subjective reality. At present, this area of knowledge is completely unexplored. We can only outline the approximate range of problems that will be dealt with in these disciplines. First of all, it is a problem of the artificial picture of the world created by the techno subject in the course of its development in the conditions of integration of artificial sensory-perceptual systems and accumulation of experience. The creation of artificial sensory systems that perceive different from human spectra of physical influences will lead to the emergence of a special ecological niche of an artificial being and special forms of relations between him and man. In the consciousness of the artificial individual, a multidimensional image of the reality in which he acts arises, and this reality can be strikingly different from the human one. Synthetic psychology is a discipline cross-border with synthetic biology and studies the methods of creation and consequences of social and other existence of mental structures implemented with the help of various technologies, including artificial Assembly. The problems of creation of intelligent systems including those with specified or previously unknown functions and properties are considered.

One of the important questions of this discipline will be the question of the minimum possible structure that generates the psyche and stable forms of

consciousness. In addition, the psychological characteristics of a modified person endowed with:

- artificial organs and sensory systems (including new functions and properties);
- artificial emotions;
- artificial consciousness;
- artificial memory (hybrid, distributed and embodied in information environments, etc.).

Note that now we do not know much about the essence of the emerging artificial mental phenomena, the ranges and boundaries in which they exist, which would allow us to move to the solution of technological problems of techno-modification of the man and the creation of artificial intelligence. To date, the creation of interface associations "man-machine" did not affect the essential features of subjective reality, namely:

- multi-media character, manifested in the integrity of perceptions and the presence of qualitative organization, reducing the spectra of physical effects on perceptual systems in subjective images;
- presence of space-time structure and event character of changes reflecting cause-and-effect relations of the objective World;
- the Presence of the subject playing the role of an active observer and actor.

Intervention in the perceptual sphere of a person, the expansion of its capabilities allows the cognitive system of a person to more effectively use the ranges of electromagnetic waves inaccessible to the natural senses. However, at present this operation is performed only by hardware conversion of the ranges of interest to perceptually accessible forms using electro-optical converters, thermal imagers, night vision devices, ultrasonic sonars, etc.). The introduction of new sensory forms into the subjective sphere of man from the moment of his birth will require the creation of a new sphere of engineering and humanitarian knowledge, which can be called *sensory engineering*.

Technomodification of subjective reality is a form of purposeful change of properties of subjective reality of the person by means of technologies, and here the main role is played by technologies of genetic engineering and neurobiology which reflect a materialistic picture of the world. The relationship between mental and physical States and processes is studied. However, many scientists deny the possibility of "reduction" of mental phenomena to processes in the Central nervous system [33]. According to them, the mental controls the physiological processes of the brain, which create the conditions for the emergence of mental regulation.

The psychology of emerging artificial sensory forms in addition to human psychology in the natural world is taking its first steps and it is very important that it does not fall victim to technocratic ideas about life.

Artificial senses lead to the appearance of artificial additional modalities in the consciousness and



subjective reality of the modified person. Additional or modified senses are possible. It is important how they can be integrated into a consistent picture of the world of the subject, providing him with the right and opportunity for a happy and dignified life.

Note that systems with artificial consciousness are systems that generate their subjective world and generate an acting subject, realizing the goals of their existence. The concept of "subject" reflects the properties of a holistic self-organizing system endowed with a mechanism of consciousness, oriented in the world manifesting the properties of personality. However, it is impossible to know what kind of personality will be formed in the process of artificial life, since it is the result of the evolution of a self-organizing system, interference in the work of which destroys the mechanism of self-organization.

Popular in the engineering environment, the idea of endowing a reflexive artificial system with the necessary personality traits does not take into account the holistic nature of the personality, its non-reducibility to the sum of independent traits. For example, in the model of V. A. Wittich, a person in the social ergatic system proposed by Him is considered as a rather limited being whose personal properties can be neglected [34]. The author left him only functions "atomic Holon" and opportunities manifestations of "sense of solidarity". This is clearly not enough for systems that model the behavior of an active person.

In conclusion, we can conclude that humanity is only at the initial stage of creating systems like living systems endowed with consciousness and reason. Solving these problems will require the mobilization of the scientific community in the field of natural Sciences, Humanities and technical Sciences.

## References

1. **Sergeev S. F.** On the way from bio-organization to cyber-organization: man in the shadow of artificial intelligence, *Natural and artificial intelligence: methodological and social problems* / ed. by D. I. Dubrovsky and V. A. Lektorsky, Moscow, "Canon+", ROOI "Rehabilitation", 2011, pp. 48–59 (in Russian).
2. **Sergeev S. F.** Psychological foundations of the problem of artificial intelligence, *Mekhatronika, Avtomatizatsiya, Upravlenie*, 2011, no. 7, pp. 2–6 (in Russian).
3. **Global future 2045.** Convergent technologies (NBICS) and transhumanistic evolution, Ed. by D. I. Dubrovsky, Moscow, IBA Publishing house, 2013, pp. 158–168 (in Russian).
4. **Chekilezov V. V.** Sense of the planet (Internet of Things and the next technological revolution), Moscow, Russian research center for the Internet of Things, 2013 (in Russian).
5. **Stanislaw Lem.** *Summa Technologiae*. Minneapolis, MN, University of Minnesota Press, 2013. 448 pp.
6. **Bykov E.** NBIC-convergence of technologies: a historical review. Part I: 2001–2006, *NBICS-Nauka. Technologies*, 2017, no. 1, pp. 12–24 (in Russian).
7. **Bykov E.** NBIC-convergence of technologies: a historical review. Part II: 2007–2013, *NBICS-Nauka. Technologies*, 2017, no. 2, pp. 24–36 (in Russian).
8. **Vinge Vernor** (30–31 March 1993), The Coming Technological Singularity, Vision-21: Interdisciplinary Science & Engineering in the Era of Cyberspace, *Proceedings of a Symposium held at NASA Lewis Research Center (NASA Conference Publication*

*CP-10129*), retrieved 2007-08-07. See also this HTML version, retrieved on 2009-03-29.

9. **Kurzweil R.** *The Singularity Is Near*, New York, Viking, 2005.
10. **Sergeev S. F.** Reflexive autoevolution of global intelligent technogenic environments, in *Reflexive Processes and Management*, Proceedings of the IX International Symposium October 17–18, 2013, Moscow, Rev. ed. Moscow: "Kogito-Center", 2013, pp. 245–248 (in Russian).
11. **Ulam Stanislaw** (May 1958). Tribute to John von Neumann, 64, #3, part 2, *Bulletin of the American Mathematical Society*: 5.
12. **Zinchenko V. P.** Psychological bases of pedagogy (Psychological and pedagogical bases of construction of system of developing training D. B. Elkonin, V. V. Davydov), Moscow, Gardariki, 2002, 431 p. (in Russian).
13. **Zinchenko V. P.** Reflections on the soul and its education (Hour of the Soul), *Expanded version of the report at the International Symposium "Spirituality of childhood"*, Machida (Japan) August 21–22, 2001, 2001, 33 p. (in Russian).
14. **Kratin Yu. G.** *Neurophysiology and theory of reflection*, Leningrad, Nauka, 1982, 84 p. (in Russian).
15. **Sergin V. Ya.** Consciousness and thinking: neurobiological mechanisms, *Psychological journal of the international University of nature, society and man "Dubna"*, 2011, no 2, available at: <http://www.psyanima.ru> (in Russian).
16. **Dubrovsky D. I.** The problem of the ideal. Subjective reality, Moscow, Canon+, 2002, 368 p. (in Russian).
17. **Kriman A. I.** Idea of the Posthuman: a comparative analysis of transhumanism and posthumanism, *Philosophical science*, 2019, 62(4), pp. 132–147 (in Russian).
18. **Huxley J.** *Transhumanism*, in Huxley, J., *New Bottles for New Wine*, London, Chatto & Windus, 1957, pp. 13–17.
19. **Hayry M.** Categorical objections to genetic engineering – a critique, *Ethics and Biotechnology* / eds. A. Dyson and J. Harris, L.; N. Y., Routledge, 1994, pp. 202–215.
20. **Vvedenskaya E. V.** Bioethical analysis of the contradictions of transhumanism, *Vestnik MITHT, Series: Social and Humanitarian Sciences and ecology*, no. 3, 2014, pp. 35–40 (in Russian).
21. **Mareeva E. V.** From artificial intelligence to artificial soul, *Questions of Philosophy*, 2014, no. 1, pp. 171–177 (in Russian).
22. **Arshinov V. I., Andreev A. L.** Technoscience and the problem of man, *Vestnik MEI*, 2011, no. 4, pp. 110–116 (in Russian).
23. **Litvak L. M.** "Life after death": near-death experiences and the nature of psychosis: the experience of self-observation and psychoneurological research / ed. article by D. I. Dubrovsky. Ed. 2nd, remade and additional, Moscow, Canon+, 2007, 671 p. (in Russian).
24. **Dubrovsky D. I.** Problem of neurodynamic code of mental phenomena, *Questions of Philosophy*, 1975, no. 6, pp. 84–95 (in Russian).
25. **Sergeev S. F., Sergeeva A. S.** Man in complex technical systems: the problem of consciousness, *Proceedings of the Second International scientific and practical conference "Human factor in complex technical systems and environments" (Ergo-2016)* (St. Petersburg, Russia, 6–9 July 2016), St. Petersburg: interregional ergonomic Association, PEIPK, Severnaya Zvezda, 2016, pp. 66–72 (in Russian).
26. **Edelman G.** *The Remembered Present: A Biological Theory of Consciousness*, N. Y., Basic Books, 1989.
27. **Ivanitsky A. M.** Synthesis of information in key departments of the cortex as the basis of subjective experiences, *Journal of higher nervous activity*, 1997, vol. 47, no. 2, pp. 209–225 (in Russian).
28. **Metzinger T.** (2009). *The ego tunnel: the science of the mind and the myth of the self*. New York, NY, US, Basic Books.
29. **Blanke O., Orligue S., Landis T., Seeck M.** Stimulating illusory own-body perceptions, *Nature*, 2002, vol. 419, pp. 269–270.
30. **Lenggenhager B., Tadi T., Metzinger T., Blanke O.** Video Ergo Sum: Manipulating Bodily Self-Consciousness Science 24 August 2007, vol. 317, no. 5841, pp. 1096–1099.
31. **Maselli A., Slater M.** (2014). Sliding perspectives: dissociating ownership from self-location during full body illusions in virtual reality. *Frontiers in Human Neuroscience* 8:693.
32. **Sergeev S. F.** Psychology of technointegration and technomodification of man: theoretical and methodological basis, *Actual problems of labor psychology, engineering psychology and ergonomics*, iss. 8, ed. A. A. Oboznov, A. L. Zhuravlev, Moscow, Publishing house "Institute of psychology RAS", 2018, pp. 30–49.
33. **The Self and Its Brain: An Argument for Interactionism** by Karl R. Popper and John C. Eccles, Berlin, Springer-Verlag, 1977, xvi + 597 p.
34. **Witte V. A.** Kognitologiya developing systems, *Mekhatronika, Avtomatizatsiya, Upravlenie*, 2011, no. 10, pp. 45–50 (in Russian).