Vitasystemic approach to conflict mitigation in biohybrid information systems*

На английском языке. Совместно с Г.А. Алакозом, Е.Н. Быдановой, С.И. Пляскотой

Introduction

‘Global digitalisation’ and the excessive penetration of artificial intelligence systems into all spheres of human activity require a clearer definition of the boundaries between the ‘artificial’ (produced by man) and the ‘natural’ (produced by nature) and no longer from purely philosophical, but from applied, managerial positions of development methods and means of *engineering creativity*, the results of which have already become an integral part of our ecosystem.

Even in the report of the Ministry of Defense of Great Britain “Strategic context of the future” (DCDC, 2010), the basic benchmarks of technological foresight in cybernetics, industry, medicine, gerontology, agriculture, ecology and other socially significant strata were determined and the implications of mastering nanotechnologies not implemented without computer functionals, which are called ‘artificial intelligence’ (AI). In the report materials it is noted that:

- “... in cybernetics the possibilities of natural and ‘artificial’ intellects will come as close as possible due to the development of neural-like computing technologies on protein hardware platforms”, and in the field of space exploration there is an opportunity to “... prepare using near-earth nanorobots for human colonisation”.
- The creation of AI itself is inextricably linked with the formation of multi-purpose biohybrid systems and it is recognised that this trend is one of the strategic trends of technological progress of mankind.

The success of solving the above tasks largely depends on the quality of the establishment of the boundary between artificial and natural intelligence, which requires a transition:

- to a unifying, not opposing living and non-living, reduction model in which mass-energy and information processes are inextricably linked, and as elements are (sub) systems with a ‘lower’ level of structural and functional complexity
- to extensional methods and means of evaluating the results of transdisciplinary forms of activity that allow ‘to measure the incommensurable’ and ‘to compare the incomparable’, as they are based on the differential assessment of the ‘contribution’ of each factor of an arbitrary physical, biological, psychophysiological and social nature to the target functionality of the biohybrid system
- to the new target functionals of the synthesis and operation of information and communication and cybernetic systems, focused on preserving, above all, biohybrid integrity and unity, which implies the impossibility of the functioning of such systems in violation of the material and informational connections between artificial and natural intelligence.

Such a reduction-based model was called the vitasystem (Ayupov et al., 2019) and it comes from the following intuitively clear statements:

- reduction is the inevitable effect of structurisation of material objects and the processes of their interaction, starting with the inanimate nature, where the ‘atomisation’ of heterogeneous elementary particles allows them to be divided into ‘structural’ and ‘functionally significant’ (Alakoz et al., 2017, 2018)
- it is not necessary that the system be a (sub) system from the nearest level of structural and functional complexity of material processes and objects
- the mixing in one system of elements belonging to different levels of the hierarchy, starting from the subatomic and ending with (zoo) social, is an attribute of the vitasystems, where the main active and purposeful element is concentrated in the living component
- the ‘complexity’ of any structure is characterised not only by the number of elements and their connections, but also by the singularity of the mechanisms used in their synthesis and manifested in their functioning, starting from the atomic level of complexity.

It is important that the reduction drastically reduces, not only in the living, the dimension of the tasks of controlling the interaction of ‘elementary’ particles, but the control itself is carried out on the principles of distinguishability of

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controlled objects supported by their specific properties (Alakoz et al., 2017, 2018) which does not exclude the possibility of creating ‘homogeneous’ physico-chemical structures, the synthesis of which is determined by statistical laws, as is the case with dissipative structures (Nikolis and Prigogine, 1977).

The creation of biohybrid information systems and their aerospace components is associated with the resolution of the whole complex of the above contradictions. Such systems have already become an integral part of the ‘environment’ of our habitat, they function relatively autonomously, in real time, and are economically repayable with a ‘lifetime’ exceeding 7–10 years.

As a result, computational technologies that support AI objectively become one of the main sources of threats to the normal functioning of large-scale human life support systems, and these threats arise both in the course of their operation and are incorporated in them during design, which is due to:

- lack of knowledge of the subject area
- the costs of the homomorphic representation of the subject domain by abstract models
- poor predictability of the consequences of information failures and hardware failures affecting the target functionality of the entire system.

Purpose of the paper: to reveal the system-engineering potential of structural-parametric methods and means of storage and transformation of information created on their basis, reducing the risk of the emergence of ‘deadly embraces’ caused by catastrophic conflicts between artificial and natural intelligence, which is fraught with loss of control by global information systems (for example, aerospace component).

Features of material processes supporting artificial and natural intelligence

The creation of AI, and with it biohybrid systems, is inevitably associated with a transition from ‘subject’ to ‘abstract’ thought, the first of which is based on the “wordless” perception of the external world by our senses, and the second is always clothed in a verbal form that is characteristic only of man , and therefore, according to the accepted canons, it represents the highest abstraction in the evolutionary, and not the formal logical sense.

A fairly general scheme of such a transition was developed by I.M. Sechenov, who showed (Sechenov, 1947):

- All the infinite variety of wordless objective thoughts, ultimately, can be reduced to their standard verbal representation in the form of a three-term sentence consisting of a subject, predicate and bundle. At the same time I.M. Sechenov stipulated that this form of verbal abstraction is not applicable to emerging or emerging thought, but to one that has already formed, and thanks to this very simple, open and developing by its nature form of abstraction, humanity is quite successfully maintaining a communicative connection between peoples and nationalities and between all generations starting with the primitive.
- “In objective thought, the subject and predicate always correspond to some real facts perceived by our feelings from the outside world. Therefore, the common thing between them is that they are the product of effects on our senses”.
- On the contrary, the verbal image of the connective “… is deprived of an ordinary objective character; it expresses the attitude, connection, dependence between the subject and the predicate”, and it is the connective that determines the meaning of thought, since without it “… the subject and the predicate would be two separate objects …”.
- The whole variety of relations between objects of the external world, represented by the subject and predicate, can be reduced to three main categories: “… coexistence, succession and similarity”.

These data indicate a fundamental role of:

- verbal methods and means of representing the project being created, the inevitable ambiguities of which led and lead to errors with poorly predicted consequences for global systems, which, like any complex systems, according to the winged expression are ‘easier to do than describe’
- associative methods and means not only in the cognitive activity of a person, but also in the materialisation of his knowledge, the central role in which is played by the relationship between the ‘representing’ substrate and the ‘information’ presented by it.

Modern AI supporters, while maintaining the switching paradigm of ‘presenting’ information, actually follow in the footsteps of Pribram (1971), who laid the holographic principle at the heart of the ‘special neural organisation’. But in the traditional models of formal neurons, and in the holographic models of Pribram (1971), the fact that even in the simplest organisms the cell membrane acts not only as a threshold barrier in mass-energy and information exchange with external environment, but also as a hybrid physico-biological substrate-mediator, in which not only unconditional and basically gradient physical mechanisms are preserved, but conditional and selective biological mechanisms of such an exchange become possible.

Indeed, for unconditional spatial diffusion of mass and energy distribution in ordered and disordered physical media, a gradient of the density of matter and/or potential difference is sufficient, while in biological media, the formation and functioning of which is due to the specificity of substrate-enzyme complexes that make internal and external interactions singular not only by the result, but also by the complex of conditions for their implementation (Alakoz et al., 2017, 2018).

Such singular mechanisms allow you to use:

- bidirectional and selective diffusion of biological and physical mass through an essentially hybrid membrane (with possible preliminary destruction of the substrate and, at least, with its inevitable conformational transformation), not only with the aim of maintaining an ‘internal’ mass-energy balance, but also for informational exchange that does not upset this balance
- the membrane as a hybrid physical and biological substrate mediator (interface, buffer medium) for bidirectional and selective propagation of disturbances with the translation of modalities and transformations of space-time formats, which is a necessary condition for supporting homeostatic internal mass-energy interactions.

The above features of the functioning of neuronal and subneuronal structures of the brain allow us to consider neurons not as ‘black boxes’ included in the support structures for switching and memory functions, but as a specific biological substrate for supporting integrative activity, due to the fact that “… the process of transformation of excitation does not only stop at subsynaptic membrane, but also actively develops in the postsynaptic cytoplasm, in contact with various organelles of the dendride” (Anokhin, 1974).

As a result, the author of the idea of the integrative activity of individual neurons, Academician P.K. Anokhin and his followers (Anokhin, 1974; Kositsyn, 1974) managed to discover a wide range of neurochemical and neurophysiological mechanisms of convergent closure of conditioned reflexes, and the ‘closure’ itself, which manifests itself in the establishment of a conditional causal relationship biologically significant for the whole organism between the stimulus and reaction, is supported by bi-directional mass-energy and information exchange within the neuronal and proper neuronal structures. It is thanks to such integrative activity of individual (convergent) neurons that the previously indifferent stimulus (light, sound) becomes biologically significant for the whole organism, stimulating the release of saliva in classical schemes of conditioned reflexes (Alakoz et al., 2017).

In all these and subsequent studies, the integrative activity of a neuron is understood (Anokhin, 1974; Kositsyn, 1974) to process diverse information, and the inclusion of a neuron in the overall activity of a certain functional system that supports the achievement of a result useful to the whole organism will inevitably limit the degrees of freedom, which in physical terms can interpret as a singular ‘narrowing’ of the symmetry of the space of possible states. If we take into account that the operation of AI is directly or indirectly described in a Boolean operational basis, both with computer and with neurocomputer hardware support, then in this interpretation of the degrees of freedom of a neuron there is nothing unusual, since:

- mechanisms for implementing any Boolean function can be represented by the corresponding elements of the symmetric group of transformations (Alakoz and Salomatov, 2007)
- any ‘specialisation’ of a universal logic module is customisable to an arbitrary Boolean function from a certain class, transforms it into a multifunctional logic module that implements only part of the Boolean functions of a universal.

From the above follows that:

- the inclusion of a neuron in one or another functional activity of the whole organism is inevitably associated with the imposition of restrictions on ‘degrees of freedom’ according to Anokhin (1974), and hence its potential functionality due to the introduction of dissymmetry in its metabolic processes
- the integrative activity of neurons is carried out due to the local, but nonetheless, homeostatic restructuring of its metabolic processes, the consequences of which do not always manifest themselves in changes in the electrophysiological parameters of their activity recorded from outside
- if the processes of production and operation of AI hardware and software platforms are separated in time and space, then similar processes in natural intelligence are inextricably linked together by a single metabolic cycle.

The practical implementation of the principles and methods of organising calculations in real life has shown (Alakoz et al., 2017):

- with an increase in the structural and functional complexity of the used mass-energy substrate and the 'Boolean' product obtained on its basis, the accumulation of singularities with respect to the primitive switching function occurs; in other words, the more complex the structure, the more it has accumulated 'exceptions to the rules' in relation to the 'original' switching structure
- not only the quantity and range of changes in the measured or observed quantities used in controlling neurochemical and molecular biological reactions contribute to the creation of the potential of 'degrees of freedom', but also the relationships between them
- a change in the rules of functioning of universal logical modules due to a change in the relationship between the observed parameters of the metabolic processes of neurons is not necessarily accompanied by a violation of the conditions of their homeostaticity, since it is estimated by integral rather than differential indicators
- in order to use the potential of relations in information processes, it is necessary to supplement the classical methods and mechanisms of information coding with methods and mechanisms based on the comparison (comparison) of the observed parameters, which by their nature can be of different quality and in some way 'meaningless', but informationally useful (not to be confused) with different modality of signals that can be used to represent the same process!).

Thus, based on the above features of the subject area used to implement artificial and natural intelligence, we can conclude:

- If the functioning of AI is supported by transient solid-state or optoelectronic processes between two stable states, then the functioning of natural intelligence can be supported and, most likely, supported by molecular biological and neurochemical processes in which the differential relations between the observed parameters change and the integral parameters characterising the mass energy stability of metabolic processes. In this case, changes in ratios can be local and short-term.
- The manifestation of our own continuous and 'spike' electrophysiological 'activity' of neurons is guaranteed to serve as an indicator of the internal structural and functional changes occurring in them, while the actual information transformation can be carried out on the basis of irritability of the nervous tissue, creating a computational potential hidden from us that does not manifest itself and cannot manifest itself in observable electrophysiological parameters.

Features of the structural-parametric method of storing and converting information

The problem of using the potential of hidden computing, which uses factors of short-term and local changes in the relationships, including between 'meaningless' combinations of parameters that have no effect on the stability of the metabolic processes of neurons, is largely similar to the collapse of the wave function in quantum mechanics with the difference that it can be resolved using the earliest structural and parametric methods of storing and transforming information that are characteristic of all living things, and therefore evolutionarily, physically invariant the molecular, biological, or neurochemical nature of material information carriers (Alakoz, 2007).

Apparently, E. Lugaro was one of the first who proposed to consider learning as a continuation of embryonic development, understanding by 'plasticity' the structural and functional transformations occurring in the brain during its maturation and learning (Berlucchi, 2002).

If P.K. Anokhin considered systemogenesis as selective and heterochronous maturation in the prenatal period (Anokhin, 1948), which creates or at least limits the potential of the adaptive activity of the body, then his students went further and extended the principles of systemogenesis to the 'more operational' tasks of establishing functional systems in the adult organism (Sudakov, 1979) up to a specific behavioural act, considered from the standpoint of training a mature individual (Shvyrkov, 1978).

Subsequently, the principles of systemogenesis were extended to the molecular mechanisms of (long-term) memory (Anokhin, 1997; Rose, 2003), the functions of which can be performed by atoms, molecules, subneuronal and neuronal structures with a finite 'life time'. Despite the lack of generally accepted data on the intensity of renewal in living atomic and molecular, subneuronal, neuronal and other structures, it has already been recognised that both the genetically programmed process of cell death (apoptosis) and the destructive processes of death of nerve fibres and subsynaptic structures from the standpoint of the unity of the processes of development and integrative activity of the brain in solving 'everyday' tasks of the adult body (Sherstnev et al., 2001; Sherstnev et al., 2006; Sherstnev, 2007).

Formalisation of the natural science data resulted in the creation of a structuralparametric method for storing and transforming information (Alakoz, 2007), which:

- uses not the traditional numerical, but the set-theoretical interpretation of the work of intelligent machines, proposed by S.N. Korsakov back in the 19th century (Mikhailov, 2015)
- based on formal-logical *PD*-associative computational constructions, the main feature of which is that the contents of one of the operands controls the synthesis

  of a computational structure that changes its composition and interaction of elements according to the requirements of an activated (stream) instruction, and the function they implement is significantly ambiguous character, as it depends on the contents of another exciting operand
- based on the fact that in real conditions one of the operands being processed is encoded by the structure of the material substrate used (composition of elements and stable galvanic, physicochemical or molecular biological bonds), and the second by the parameters of locally exciting but non-destructive signals.

The spread of the structural and parametric method of storing and converting information to AI systems, characteristic of all living things, entails the following system-technical consequences for the latter (Alakoz et al., 2009).

1 A centralised or distributed instruction flow initialisation system critical for (super) parallel computing systems is replaced by local means of instructed synthesis of switching and memory devices, the structure of which adapts to a given operational function and depends on the contents of one of the processed operands.

2 The processes of production and operation of material *PD*-associative structures are combined in time and space, which radically changes the requirements for operational hygiene, which must be supported by controlled destructive processes and semipermeable membranes. Together, these processes are designed to provide selective exchange with the ‘external’ environment, not only the initial substrate and the irrelevant product, but also excess or deficient energy.

3 The processes of parrying failures inherent in highly reliable computers are replaced by forced regeneration of structures with a predetermined ‘life time’.

4 Destructive processes in a material information carrier become an integral part of the process of (re) generating distributed, functionally polymorphic *PD*-associative structures. Therefore, they must be either controlled or instructed, both temporarily and in the structurally functional plane. In fact, we are talking about the constructive and destructive phase of a single process of instructed synthesis of heterostructures in semi-open type systems.

5 Synthesis algorithms and the thermal composition of the material substrate form an interdependent and indivisible abstract-logical and material complex that interprets in the group-theoretical representation the functional of the initialised (flow) instruction.

6 Distributed *PD*-associative structures preserve the structural-functional polymorphism characteristic of concentrated programmable operating devices and make it dependent not only on the contents of the stream operand, but also on ‘spurious’ external influences.

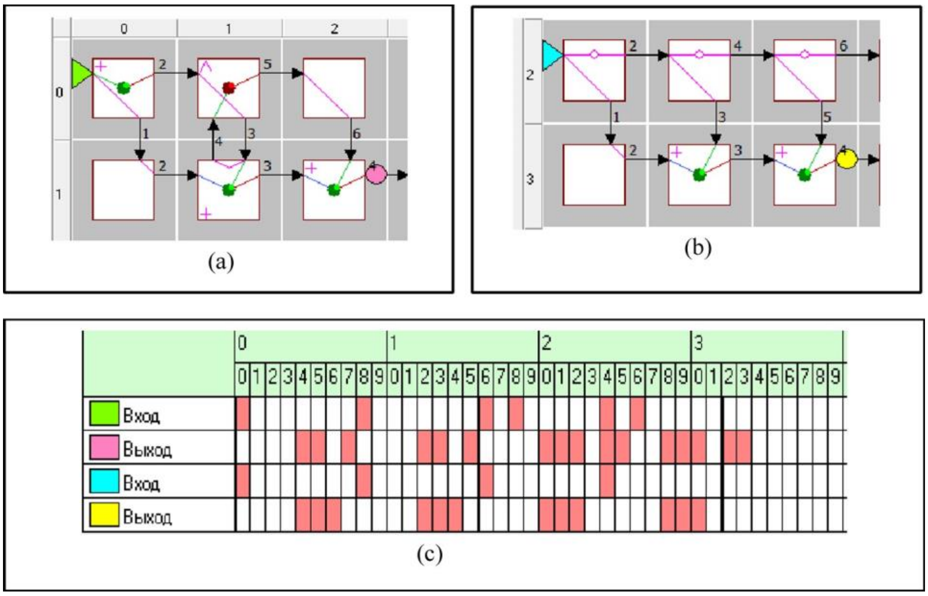
7 Concentrated operating, switching, and control devices are excluded from the classical computer architecture, and all data stream processing is transferred to a structurally adaptable *PD*-associative instruction memory with a micro-command or gate access level, which corresponds to the ideal of the ‘processor in memory’ technology studied for the needs of promising super-Computer, where according to (Elliott et al., 1999) one of the main sources of reducing throughput by 1–2 orders of magnitude is the processor-memory information exchange subsystem.

All the above basic paradigms of the structural-parametric method are implemented in solid-state performance, which has been tested in aerospace applications with the most stringent requirements for specific productivity, mass dimensions, fault tolerance, and fail-safe (Alakoz et al., 2009).

The systemic potential of structural-parametric methods and means of storage and conversion of information

The high structural and functional adaptability of *PD*-associative computational constructions (Alakoz, 2007) is illustrated by Figure 1, which presents topological diagrams of computational structures on associative memory cells with cells horizontally and vertically randomly commutated (Alakoz et al., 2009). Schemes work in sequential pipelined arithmetic, and the ‘least significant’ bits of the converted and resulting data in the time diagrams are interpreted starting from the left.

Figure 1 Topological schemes and timing diagram of PD-associative multipliers: (a) multiplier 11**X*, (b) multiplier 11**X* and (c) time diagram of multipliers 11**X* and 7**X* (see online version for colours)



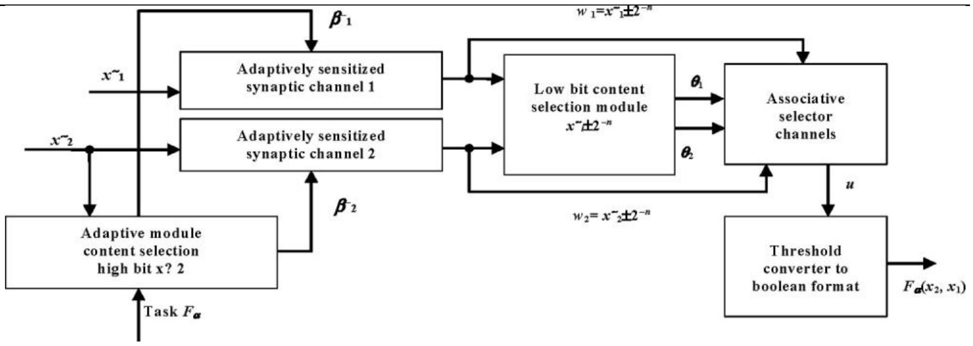
It can be seen from the figure that in *PD*-associative computational constructions the basic principle for the adaptation of all living things is used to extract the ‘simpler’ function from the ‘more complex’ one. Indeed, schemes 1-a and 1-b implement the same ‘more complex’ function $F(A, X) = A*$□X□, in which the scalar operand A = const is contained in the structure of the corresponding operational module, defining it purely individual topology, and the contents of the stream operand □X□ defines a realisable ‘computational’ function: ‘storage A’ if □X = 1000.0000□, and ‘multiplication $A*X$’ if $X = var$.

In *PD*-associative computational constructions, the effect of parry failures is achieved due to the high structural and functional plasticity, due to which it is possible to tolerantly redistribute tasks to associative memory cells (Alakoz et al., 2009). With these methods and means, with a multiple (30–40) percent hardware reserve with a probability of 0.7–0.8 (Alakoz et al., 2010), at a rate close to real time, it is possible to fend off about 27–30 failures occurring in associative memory cells, which is practically the order exceeds the capabilities of classical majority redundancy schemes.

The structural-parametric method of storing and converting information allows you to abandon the basic ‘switch’ conductor-insulator paradigm for semiconductor electronics and switch to the basically analogous ‘sensitive’ paradigm and the corresponding sensitisation logic, operating with ‘reduced’, ‘increased’ and ‘neutral’ sensitivity (Alakoz et al., 2018). Within the framework of such logic (Figure 2), the integrative function is implemented by an associative selector that ‘grants the right to pass’ to the output of either one of the sensitised variables or their composition formed according to the ‘mounting *OR*’ rule.

This scheme works as follows. Two variables β_1 and β_2 are formed from the contents of the higher bits of the analogue input variable $\tilde{x}_2$, which control the sensitivity of the corresponding (‘postsynaptic’) distribution channels of the input variables $\tilde{x}_1$ and $\tilde{x}_2$. The output of these channels corresponds to a ‘subjective’ representation of input variables of the form $w_1 = \tilde{x}_1 \pm 2^n$ and и $w_2 = \tilde{x}_2 \pm 2^n$, from which a ‘mask’ is formed (θ_1, θ_2). This ‘mask’ sets the rule of associative selection of the value from the pair (w_1, w_2), which goes to the threshold converter, where the output binary response is generated, which corresponds to the truth table of the Boolean function $F_\alpha(x_2, x_1)$. From the above data you can see:

Figure 2 Functional diagram of the adaptively sensitised postsynaptic channels



- The circuit of Figure 2 fully corresponds to the analogue-digital paradigm of Pribram (1971) with the clarification that the physiological ‘excitation-inhibition’ in it is realised not through modulation of the passage resistance of postsynaptic channels, but by modulating their sensitivity.

- The expansion of the scope of the use of artificial intelligence at the scales defined in (DCDC, 2010) can be carried out and, most likely, will be carried out not only due to the constructive and technological improvement of the production of the component base and equipment, but also through the borrowing of principles, methods and information conversion tools based on functional (transforming) memory, tested in the process of evolution of natural intelligence. Examples of such borrowing can be given from the practice of creating robotic aviation and space systems that are biohybrid at their core, including operators (natural intelligence) and onboard information and control systems (artificial intelligence). In particular, the priorities of control actions in such biohybrid systems are chosen based on the principle of hierarchical blocking of destructive actions, borrowed, however, not always consciously, from immunology – when a cell, organ, or organism that is subjected to negative effects, includes currently available protective mechanisms in order to prevent its own death and/or catastrophe of the corresponding suprasystem.

- It is practically impossible to implement global programs of ‘intellectualisation’ of our life without taking into account the mass-energy and informational trinity, since this requires mastering a wide range of methods and means of instructed synthesis of materials with predetermined properties and spatial forms, which are already being studied in the world about half a century (Japan Science and Technology Agency, 2019).

Discussion of results

The main feature of the vitasystem approach to the trinity of mass-energy and information processes is determined by the fact that every bit of information circulating in any system has a constantly changing mass-energy ‘value’ and mass-energy representation, and find fundamental relationships and fix it once and for all an unambiguous correspondence between information and the equivalent form-forming and system-forming ‘force’ is very difficult and most likely impossible (Kotov et al., 2013), since this correspondence is manifested each time in complex and variable conditions of inextricable interaction of the human body with its physical and social environment. This leads to the need to use context-sensitive ‘grammars’ for each system and the conditions for its use, which make up the core of the AI used in the design and operation of each vitasystem.

Such a contextual dependence and ambiguity between information and the equivalent form-forming and system-forming “force”, and not only in the living, is one of the main sources of conflicts between artificial and natural intellects, which is confirmed by the practice of operating technotronic aerospace systems, the operation of which, in principle, is impossible without the use of computers.

It is possible to prevent the appearance of such conflicts in the vitasystems only in each specific case, and not in a general form, since the conflict itself is objectively an internal mobilisation source for the development of any biohybrid system, and its ‘energy’ is consumed in two ways (Kotov et al., 2013):

- to read and use the genetic instructions recorded in the genome, and significantly predetermining the individual course of the internal processes of the body at various levels of their organisation: from molecular to psychophysiological and personal

- to ‘revitalise’ for the subject the most diverse (previously indifferent) stimuli and events in the external environment.

It is not yet clear how the internal ‘energy’ of the conflict is accumulated in a living one, but it is already clear that due to the “… ‘impressionability’ of conflict-induced or conflict-containing dominants in the body, a ‘vector’ of constant ‘functional development’ is provided and self-improvement of the subject, which is limited only by the terms of his biological life” (Kotov et al., 2013).

For comparison, computer scientists have so far managed to present the Turing machine only as a 'self-reproducing' automaton, which is difficult to recognise as developing, since it is not able to independently resolve the Gödel restriction on the incompleteness of any formal system fraught with 'deadly hugs'.

Based on the above, development of the theory of vitasystem and vitasystemic approach in the field of biohybrid information systems may be proposed on the study of *singular mechanisms for storing and converting information* primarily in the neural biohybrid dynamic aerospace systems for which the requirement of fault tolerance and fail-safe is on the first place, but selective screening is the basis of the control of distributed structures.

Conclusions

The logic of development of artificial and natural intelligence systems, confirmed by practice, suggests that they need to be considered as a single vitasystem conglomerate, in which AI remains problem-oriented and requires the implementation of certain rules for using a computer product, 'borrowed' from natural intelligence with its purely individual history of the transition from objective thinking to abstract. At the same time, the creation of AI itself has a clearly expressed transdisciplinary character, inextricably linked with the creation of biohybrid systems in a wide range of applications, which is impossible to implement without taking into account the specifics of material laws and laws that operate in the subject area.

The fundamental difference between the material processes of supporting artificial and natural intelligences, the last of which is used in all phases of the creation and use of the first:

- the processes of production and operation of software and hardware platforms in AI are separated in time and space, and each external perturbation of the valves in the general case leads to a corresponding transient process, while the processes of 'production' and 'operation' in natural intelligence are combined in time and space, forming a single metabolic cycle, the local changes of which form the material basis of the integrative activity of neurons
- the evolution of the living does not discard the earlier control mechanisms, but fills them with new meaning, as a result of which the whole variety of psychosomatic interactions in the body is supported not only by the convergence of signals from different sources, but also by multi-stage context-dependent translation of various, including relict forms Presentation of information: physico-chemical, molecular biological, neurochemical
- the associated processes of neurogliogenesis and genetically programmed death (apoptosis), proliferation, migration and differentiation of nerve and glial cells are an attribute not only of the processes of growth and development in the pre- and postnatal periods, but also of the integrative activity of neurons of mature individuals that use all these mechanisms to consolidation of learning outcomes in neurochemical, subneuronal and neuronal structures (Sherstnev, 2007).

The data presented allow us to conclude:

- the computational potential of natural intelligence hidden from us is due to the fact that, unlike AI, it is based on the paradigm of 'observation' rather than 'measurement', the first of which relies on passive receptor mechanisms that have minimal effect on the observed process, while the second is based on active mechanisms of influence on the measured process, the results of which should reach and manifest, albeit in a 'weak' form, at the output of the system
- the source of unprovoked conflicts that is inevitable for developing biohybrid information systems can be both each component of this conglomerate and non-linear and poorly formalised relations between them, which, if the AI is unreasonably widespread in all spheres of human activity, is fraught with an irreversible violation of the global co-evolution balance (Timofeev-Resovsky et al., 1969)
- the high structural and functional plasticity of *PD*-associative computational structures allows you to quickly smooth out the consequences of unintentional conflicts that have already arisen, which lead to the formation of 'deadly hugs' in biohybrid information systems, both due to operational tolerant regeneration of the structures themselves and due to changes in the contents of exciting signals.

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