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COMPUTER MODELING OF THE EVOLUTION OF CIVILIZATION WITHIN THE FUTUROLOGICAL THEORY OF MIND-MATTER

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КОМПЬЮТЕРНОЕ МОДЕЛИРОВАНИЕ ЭВОЛЮЦИИ ЦИВИЛИЗАЦИИ В РАМКАХ ФУТУРОЛОГИЧЕСКОЙ ТЕОРИИ МЫСЛЯЩЕЙ МАТЕРИИ

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КОМП'ЮТЕРНЕ МОДЕЛЮВАННЯ ЕВОЛЮЦІЇ ЦИВІЛІЗАЦІЇ У РАМКАХ ФУТУРОЛОГІЧНОЇ ТЕОРІЇ МИСЛЯЧОЇ МАТЕРІЇ

Computer models based on the theory of mind-matter can describe the development of intelligence regardless of its carrier (human, AI or their symbiosis). This article discusses a simple model of this type, which reflects the explosive growth corresponding to the "technological singularity".
Key words: mind-matter, futurology, modeling, structure of matter, evolution, civilization, intelligence.

Компьютерные модели на основе теории мыслящей материи способны описывать развитие интеллекта независимо от его носителя (человек, ИИ или их симбиоз). В статье рассматривается простая модель этого типа, которая отражает некоторые особенности эволюции (взрывной рост, соответствующий «технологической сингулярности»).
Ключевые слова: мыслящая материя, футурология, моделирование, структура материи, эволюция, цивилизация, интеллект.

Комп'ютерні моделі, засновані на теорії мислячої матерії, можуть описувати розвиток інтелекту незалежно від його носія (людина, ШІ чи їх симбіоз). У статті розглядається проста модель такого типу, яка відображає деякі особливості еволюції (вибухове зростання, відповідне «технологічній сингулярності»).
Ключові слова: мисляча матерія, футурологія, моделювання, структура матерії, еволюція, цивілізація, інтелект.

Introduction

The XXI-century society is facing a broad range of challenges, connected to the development of information technologies. Among them are challenges, specific to a particular technology of information processing (such as the conflict between the right to privacy and the development of face recognition [1], [2]), as well as general questions, associated with irreversible changes in the entire human civilization [3], [4].

These questions can be answered by analyzing the development of the technologies. Such analysis is becoming particularly important in the area of Artificial Intelligence [5].

The need to reconsider the role of information technology in human society is appearing due to the increasing role of knowledge in its development.

As it was noted in [6], "the history of the development of society shows a continuous increase of knowledge-part in all components of production with a relative decrease of the material-part".

This paper reconsiders the role of information technology in evolution of civilization and describes it in the very general context of the evolution of organization of information processing in matter. In this approach, the different types of such organization determine different types of matter. The type of matter-organization corresponding to a man-made technosphere is named the "mind-matter" (or "thinking matter", as it is named in russian publications). Such notation emphasizes its difference with "life"-matter organization, corresponding to biosphere). Sometimes it is also referred as "modeling-matter" (reflecting the nature of its functioning) and abbreviated as MM.

This type of organization of matter can be described by a specific philosophical concept and a specific informatic structure.

From informatic point view, the concept of mind-matter (MM) is capable to serve as a base for computer simulations of technological progress and is capable to quantitatively describe not only the increase the knowledge-part in the information civilization, but also the general inter-relation between material and immaterial components of any civilization. Moreover, this generality allows describing and creating computer simulations of development not only human, but any type of future, hybrid, transhumanistic, post-human or transition civilizations.

From philosophical point view, the concept of MM removes the question "Can computers think as humans?" [7]. Similar to most philosophical questions, it is not answered, but removed, with arriving of new paradigm, comprising both computers, humans and other similarly-organized matter. Within this paradigm the questions such as "Can computers think as humans?" become insignificant.

Philosophical concept of mind-matter (MM)

This article discusses informatic structures (types of matter) or, in more detail, types of coordination of processes of structuring matter. Particular attention is paid to the structure of "mind-matter".

The mind-matter (MM) is an informatic structure, describing interaction between information and material components of any civilization (or, figuratively speaking, between mind and matter). This description was proposed in [8-11] (the brief summary can be found in [12]). Within the framework of this description, one can consider not only the evolution of human society, but also transitions from the uniqueness of the material carrier of mind (humans) to multiple, alternative or symbiotic carriers, characteristic of transhumanism and posthumanism [13], [14]. This generality allows resolving the problem of the definition of intelligence [15] by adapting a general "more than only human" point of view on intelligence.

The notion of "type of matter" is based on the configuration of the informatic processes, performing structuring of this matter. The "mind-matter" is the one with a structure that is different from the structures characteristic of the previous types of complex organizations of matter: living organisms, chemical compounds or other different structures (composed as a result of operation of different laws of physics). In accordance with this, it is sometimes called "thinking matter" [10], [12] (to contrast with "living matter" or "life").

Informatic structure of mind-matter: IC and OC

The mind-matter (MM) is also sometimes called "modeling-matter", reflecting the fact that, in this type of organization of matter, the methods of its organization are modelled (created, improved or tested) separately from the organized matter.

In other words, compound (structured) matter is a mind-matter if it is composite, consisting of two parts: "information component" (IC), which holds and processes the information about organization and "organized component" (OC), which is being organized according to this information.

The example of IC is the human mind, processing ideas (as philosophical concepts [16] as well as scientific models) of all to-be-made objects (OC) prior to their realization. Such activity was typical, until recently, only to humans. Now this "modeling before making" activity, similarly to other human activities [17], [18], starts to be shared with artificial intelligence within robots and computers.

The "spatial boarder" between IC and OC is not fixed (in example, given below, same matter is first IC and then OC). However, the "temporal boarder" between them is impenetrable: the same matter cannot be IC and OC at the same time.

The separation between IC and OC implies that the process of creating, testing and improving the ways of organizing matter in IC is independent of the process of material realization of these ways in OC.

The IC consists from the ideal part (information itself) and material part (material carrier of information). In accordance with this, the structure of MM is defined as "ideo-material" (in opposition to "solely-material" structures, such as "living-matter" of biosphere).

The separation of IC from OC means that the information about organization is located on a material carrier, separated from matter being organized (OC).

The case when IC and OC are separated in time but not in space implies the possibility of reorganizing the very material carrier of the IC. In this case, separation in time means that, first, the information on how exactly the IC should be organized is created in IC and, second, IC is being organized according to this information. During this second phase, the material carrier of IC becomes OC.

In this way, computer-modeling is used to design future CPUs and computer architectures (and, then, humans or robots can make them), or neurophysiologists use their brains to find the medicines to improve the functioning of the same brains (and, then, make these medicines and apply them).

Since these IC and OC components of MM interact, the parts providing this interaction can also be discerned.

On the one hand, it is the "creating component" (sometimes abbreviated as IC-to-OC). It provides both the information flow from the informational (IC) to the organized (OC) components and the very process of organization the latter. The fact that the "creating component" can be separated from material carriers of both IC and OC, allows, as mentioned above, to improve both carriers themselves. In this particular process, the methods for improvement are created in IC, and then transferred to the creating component (IC-to-OC), which can, backwards, organize the material carrier of IC.

On the other hand, it is the "observing component" (sometimes abbreviated as OC-to-IC). It provides a reverse flow of information from the organized (OC) to the information (IC) component.

The material carriers of all these components (organized, creating, observing and the information), like any matter, can be organized according to the methods created in the information component. At the time of organization, any matter being organized becomes OC.

Such an ideo-material structure allows the "ideal" component (information in IC) to be separated from any material components (any matter and any material carriers).

Examples non-MM types of organization of matter

As described in [9-11], the evolution of the types of organization of matter follows the path of increasing independence of information from the organized matter. The corresponding law of evolution can be formulated as follows: increase of complexity in organization of matter implies increase the independence of information from the organized matter.

For example, in matter organized due to its physical or chemical properties (e.g. in crystals or polymers), information about the methods of organization (types of crystals and polymers) is not stored separately. This information is "stored inside" (or, more precisely, "derived from") the properties of the atoms or molecules themselves.

Another, more complex, example of compound organization of matter (life) is characterized by the fact that information about the organization of some parts of the body can be stored in other parts of it. The most prominent example is DNA, which stores, in the cell nucleus, information about its cell, as well as about the structure of other cells and organs. But, nevertheless, all this information about the organization of living matter in the body is stored in itself. We can say that the "organized" (OC) and "informational" (IC) components in a life are not separated.

Despite the fact that there are flows of information within a living organism, this information is not modelled (created, improved or tested) separately from the place of its application (apart from the organized matter).

For example, the information about the process of photosynthesis was created, improved and tested in the green parts of a living plant – which is exactly the place of its usage (exactly the matter, organized to perform photosynthesis).

Another example is the algorithm for transferring genetic information. This algorithm has never been modelled (created, modified, tested) on any other media. The information of how to create a living organism using DNA molecule has always been in the DNA molecule, in the living organism itself.

Therefore, the evolution proceeded as follows: after random changes of information in the DNA molecule, the corresponding "piece of life" was immediately organized in accordance with this changed information: the corresponding organism was born (with its own, changed organization of life) and "tested" its own set of genes.

It is precisely the lack of separate information processing (separate modeling and testing of organization options) outside the organized matter that explains the low speed of evolution of such "solely material" structures.

In particular, the "solely material" organization of life does not allow evolution of living matter to "think before doing" – the evolution of the biosphere proceeds by trials and errors.

Examples of MM type of organization of matter

The next stage in evolution of organization of matter was started then, after billions of years of such trials, the quantity of complexity of the living matter lead (in accordance with Hegelian dialectic [19]) to the change in quality of organization. The new type of organization (MM) appeared which uses even more independence of information from matter.

In particular, one of the algorithms developed in living matter – the transmission of information using electrochemical processes of the brain – made it possible not only to respond to environmental changes(events), but also to model these changes (model, inside the brain, environmental responses and events) independently from environment itself.

This processing allowed for separation the information component IC (the electrochemical state of the brain, now not only responding to the information about the environment, but also allowing to model it) and the organized component OC (the environment itself, organized corresponding to resulting models).

It is interesting to note, that the neural network approach to the tasks of information processing, found by life for humans, turned out to be also one of the most effective methods of computer processing of information – precisely then this information is related to human-specific tasks or to human-specific algorithms (when the information-processing methods need to be created not “according to the given instructions”, but “according to the given examples” [20]).

From the point of view of types of organization of matter, the neural networks in human brain allowed for the possibility of modeling the environment and one's behavior in it. Thus, a new type of organization of matter appeared on the planet (mind-matter or “modeling matter” [12]), in which the methods of organization are modelled (created, improved or tested) separately from the organized matter.

Such “human-based” modeling-matter uses human brain (IC) and human consciousness (ideal part of IC) to optimize the ways of organizing a man-made world (technosphere). Historically, it is the appearance of consciousness that signifies the appearance of mind-matter in a human. The awareness of such, characteristic to MM, “ideo-material” structure of a man and man-made world, lead to many philosophical [16], religious and psychological breakthroughs.

Consciousness implies the ability to reflect the real world (with its interconnections) into the abstract world of, roughly speaking, words and concepts (with its logic). The process of manipulating this inner abstract world in order to optimize one's behavior and the organization of the surrounding man-made world (technosphere) is the process of functioning of “human-based” mind-matter.

As some definitions of consciousness sometimes include the subjective reality, it is important to distinguish our definition of consciousness (abstract world inside the brain, able to model the real world) from “subjective reality” (world of subjective perceptions and feelings). As it is shown by modern neurophysiology, our subjective perceptions are not only very inaccurate reflection of real processes and states of the brain, but also do not make any decision at all: some modern neurophysiological experiments show that person, subjectively, thinks that he takes a decision at a certain moment, but the brain-imagery (fMRI) shows that his brain took this decision much earlier, at the moment when person was thinking that he is still in the process of hesitation [21].

That is why the abstract world was defined above as “roughly speaking” world of words and concepts. More precisely, it should be defined as world of information-processes in the brain, which we perceive as world of words and concepts. However, the “world of words and concepts” is a good approximation to the “world of information-processes in the brain”.

In most cases, we can make simulations of human-type mind-matter using this "world of words and concepts" as information in IC. It is just necessary to keep in mind, that this is approximation. The simplest example where this approximation fails is then person thinks about a certain word and makes his decision, but, the real processes of the brain took this decision, based on subconscious associations with this word.

The examples above illustrate that some aspects of "world of words and concepts" depend on deceptive subjective reality and, therefore, may produce erroneous conclusions. But this does not mean that this world belongs to the subjective reality. On the contrary, historically, it appeared as a method of sharing information.

Using this "world of words and concepts" approximation, it is possible to combine all the information in ICs (all individual consciousnesses) into a single set (knowledge of civilization). Thus, the theory of MM makes it possible to formalize the concept of the noosphere, defining it as a totality of information components (ICs) of mind-matter interacting and exchanging knowledge about information processing. The technosphere itself is the totality of all organized components of mind-matter (OCs) on the planet.

The difference between processing information in "living matter" and "mind-matter" is obvious. For example, unlike information about the process of obtaining energy through photosynthesis (which, as mentioned above, has always been stored, tested, improved and applied in the same place – in the green parts of plants), information about the process of obtaining energy through nuclear fission, was created, tested and improved not in the reactors of nuclear power plants (OCs), but in the heads of scientists (ICs). This was done by manipulating information, corresponding to the equations of physics and reactor configurations (we can omit drawings and recordings of formulas on paper since no new knowledge or results appeared in the records of formulas, they were only means of communication and a language for recording physical processes – a "glue", combining all individual ICs into "scientific noosphere"). Therefore, we can say that until the end of the twentieth century, the only carrier of the informational component (IC) of the terrestrial mind-matter was human consciousness. The situation has changed only recently. Nowadays this information is being tested and improved not only in the heads of scientists, but also in computer models simulating various processes.

From the point of view of the theory of mind-matter, computer modeling is a new, inhuman base of MM and means the beginning of the gradual escape of the informational component (IC) of mind-matter out from the limits of human consciousness.

In the near future, the information component (IC) will spread, integrate with the Internet and acquire more and more independence.

Simulations of evolution of mind in simple examples

The theory of mind-matter is not only the philosophical concept, but also an approach to model the evolution of many aspects of civilization. Moreover, imposing such, characteristic to MM, "ideo-material" structure (separating IC from OC) may help to accelerate evolution of many self-learning systems with feedback.

The simplest example of comparison of evolution of ideo-material structures (mind-matter) versus solely-material structures (similar to life or other types of organization of matter) can be made using simple planning games. One of such games which can be used to compare mind-matter planning VS solely-material planning is the following planning game. Move a chess-horse on a chess-board so that it will visit as much positions as possible (visiting twice the same cell in forbidden).

Two versions of move-choosing algorithm were developed, corresponding to choices, characteristic mind-matter (sometimes called modeling matter) and living matter, shown in a Fig. 1. The modeling matter algorithm (“horse-planning”) chooses the step by modelling all possible consequences of each of the permissible steps. The living matter algorithm (“horse-reacting”) chooses the move “instinctively”, by remembering experience from previous games (by remembering all moves leading, finally, to successes or failures).

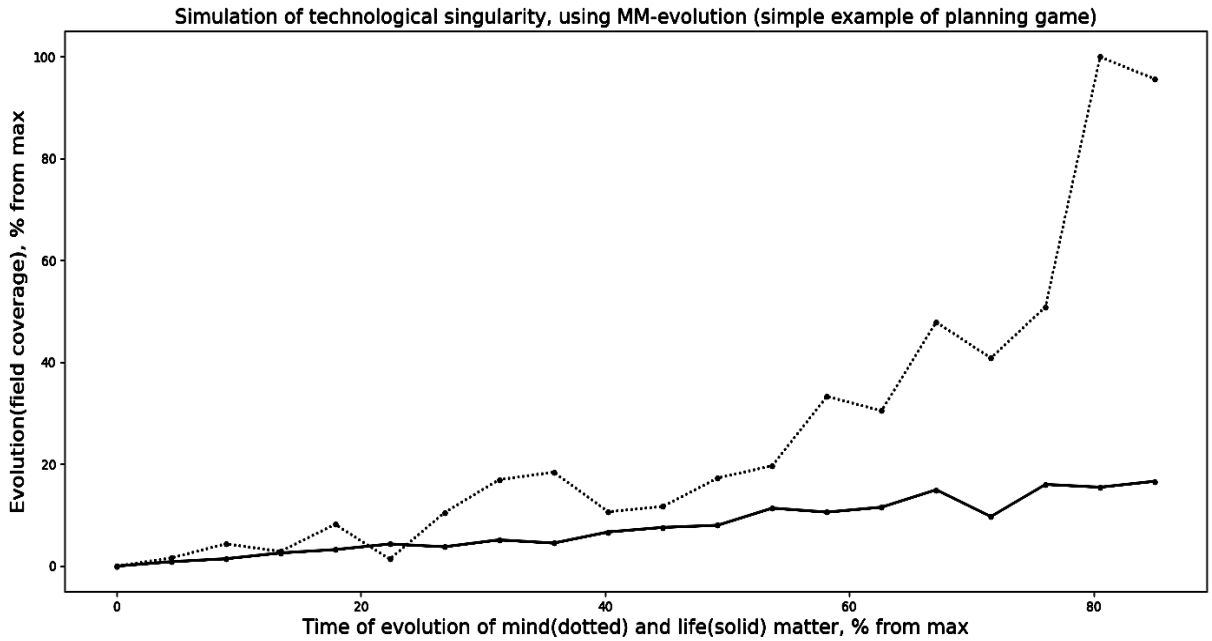

Figure 1 – Simulation of evolution, example of planning game. Learning to cover chess-board field using slow life-matter-type of algorithm ("horse-reacting", solid line) and singularly-growing mind-matter-type of algorithm ("horse-planning", dotted line)

In more details, “horse-reacting” begins with using random moves from all possible situations. During the first game, all possible moves from all possible situations are equally “attractive”. Each new game is classified as “successful”, “neutral” or “unsuccessful”. Since all “successful” and “unsuccessful” games are stored (to search during training), the threshold used for this classification depends on available memory and training-time. The “success” means covering most of the chess-board. The attractiveness of all the steps of "successful" game is increased, whereas attractiveness of steps of “unsuccessful” game is decreased. With more and more games, more and more moves from more and more situations are remembered and classified as attractive or unattractive. In each new game, if algorithm finds itself in a remembered situation, it prefers more attractive steps to less attractive. This corresponds to the process of acquiring conditioned reflex in repetitive situations. This learning is similar to those characteristic to primitive forms of life, which begin with random moves and memorize non-neutral moves, leading to pleasure or pain. These non-neutral moves, are remembered for the future situations and trigger the desire to repeat or avoid their consequences. Since the number of such situations is huge, computer simulations have shown that solely-material structures demand huge amounts of memory and degree of parallelism (to compare current situation with all the remembered situations of the past).

In contrary to this, the “horse-planning” simulates(models) the results of all possible moves according to the principle “if I do this, then the environment (situation on the chess-

board) will change like this, and I can respond with the following further moves ...” and so on. In the simplest case, the “horse-planning” algorithm constructs a tree of all possible states that can be reached from a given position. The maximum depth of this tree is limited by available RAM and CPU-time. Then the maximum depth exceeds the number of not-yet visited cells, the “horse-planning” algorithm is able to plan all possible future events. Otherwise, if the maximum depth of planning-tree is reached, the “horse-planning” algorithm starts to behave as “horse-reacting” algorithm.

This is an ideo-material structure with the organized component (OC) represented by a chessboard, and the information component (IC) represented by the “horse-planning” algorithm with whichever hardware it acts on (this IC-algorithm is the ideal part of IC, whereas its hardware is its material carrier).

The “horse-planning” is able to visit the maximum cells then the maximum depth of tree exceeds the number of cells to visit, whereas the “horse-reacting” is able to visit the maximum cells then it is remembered all positions, correctly founding the most attractive step from each position. This can happen only after a huge number of repetitive games. In real computer simulations “horse-reacting” algorithm evolves very slowly and does not have enough time to learn to fill a standard-size chess-board. It is clear that the “horse-reacting” algorithm demands much more memory for storing positions and CPU-resources to compare current position with all remembered ones.

But the most important (from the evolutional point of view) is that, as shown by these MM simulations, if the speed of modeling of methods of organization inside IC exceeds other speeds characteristic of the MM-structured system (the speed of organization of OC and speed of OC-to-IC feedback), then such a system evolves much faster than structures in which information about methods of organization is contained not separately, but inside the organized component itself.

In the case of a horse-moving game, for example, the feedback time for solely material structure is big (the feedback is received only once at the end of each game, so the feedback time is time to loss or win). The evolution of “horse-planning” is much faster as the game-time (time to win or lose) is much longer than the testing time (calculating the optimal move by the “horse-planning”).

As modeling showed, increasing of maximum depth of “horse-planning” leads to explosive patterns of evolution. Such “explosive” evolution reaches an analogue of “technological singularity”, predicted by futurologists in near-future [3].

The simulations of the simplest ideo-material structures can be used as a starting point for more complex cases, including simulations of technological growth (where the IC will reflect research activity, and the OC – the market of relevant technologies). Theoretically, similar simulations can be done for the entire human society.

For each aspect of evolution of modeling matter, computer simulation makes it possible to determine the exact time of explosive stage (“technological singularity”) for each technology or for each aspect of human society, as well as the behavior of these systems within or after the “technological singularity” stage. Fig. 2 shows combination of simulation of evolution of mind-matter-type algorithm and life-matter-type algorithm with real data of evolution of capacity of Intel processors, starting with a novel Pentium architecture and its descendants.

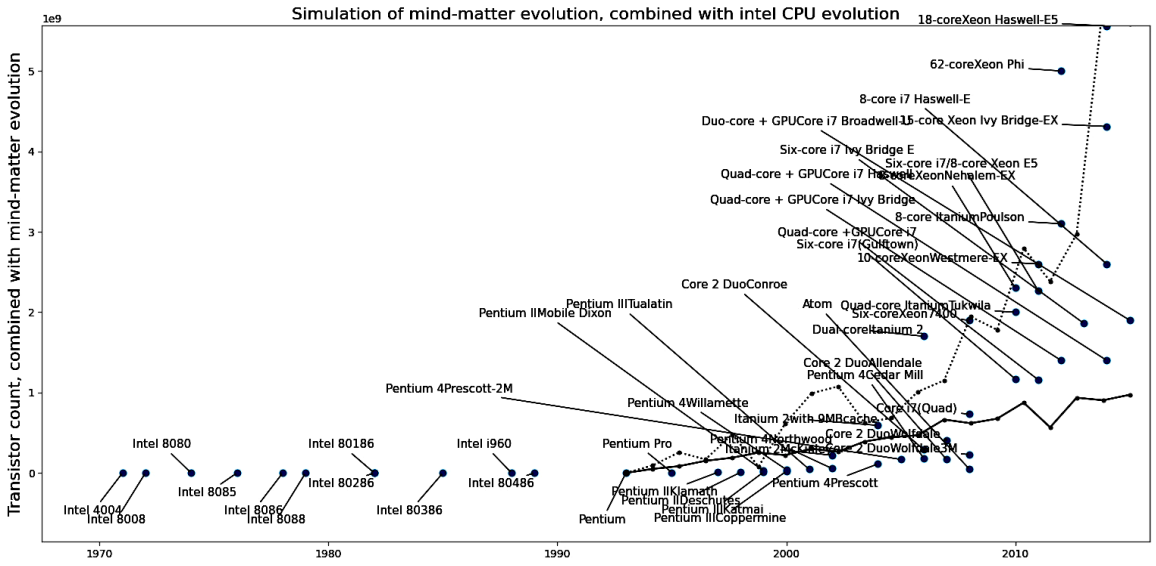

Figure 2 – Simulation of mind-matter evolution, combined with a real data of evolution of capacity of Intel processors (data from https://www.wikiwand.com/en/Transistor_count)

Futurological consequences of mind-matter theory

The main advantage of mind-matter approach for predicting the development of civilization is its independence from specific information carriers. In particular, simulations built according to the concept of modeling matter can be applied to any partition of activities between artificial intelligence and humans. While transhumanism and posthumanism rely on specific changes in the carrier of the mind (modification or replacement of a humans, respectively), the concept of modeling matter is invariant with respect to any, partial or complete, substitutions or modifications.

Another advantage is the ability to predict the optimal directions of development of artificial general intelligence (AGI) and define the areas of consciousness, necessary to simulate in AGI. For example, according to MM, the AGI and human consciousness should have common ideo-material structure: OC and IC, processing information about OC. Other aspects of human consciousness (subjective reality, feelings, personality) will have zero impact on the abilities of AGI.

Moreover, the concept of modeling matter is applicable not only to philosophical descriptions of matter and futurological predictions, but, also, to computer simulations of evolution of human, non-human or transient civilizations.

Such a replacement of anthropocentrism [22] by noocentrism [10] makes it possible to create complex models of the development of civilization, for which the technological singularity [3] is not the limit (prediction horizon), but only the transition point to another mode of growth, which MM-simulations are capable to describe.

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RESUME

A. V. Mishchenko

Computer Modeling of Evolution of Civilization within Futurological Theory of Mind-Matter

The futurological theory of mind-matter (thinking matter) provides a formalism for describing the evolution of civilizations of an arbitrary type, including human, post-human (associated with independent artificial intelligence) or trans-human (associated with people having new biological or cybernetic basis).

However, in practice, modeling the evolution of civilizations (and even modeling the evolution of individual technologies) requires taking into account a huge number of factors and, at present, is not feasible. In this regard, for the first studies, the simplest game-models of mind-matter may be useful.

This article examines one of such computer models, which, nevertheless, is capable of reflecting some characteristic features of the evolution of mind-matter, in particular, explosive growth at a certain stage, corresponding to the "technological singularity" predicted by futurologists.

РЕЗЮМЕ

А. В. Мищенко

Компьютерное моделирование эволюции цивилизации в рамках футурологической теории мыслящей материи

Футурологическая теория мыслящей материи предоставляет формализм для предсказания характерных особенностей и описания эволюции цивилизаций произвольного типа, в том числе человеческой, пост-человеческой (связанной с самостоятельным искусственным интеллектом) или транс-человеческой (связанной с людьми, обладающими новой биологической или кибернетической основой).

Однако на практике, моделирование эволюции как цивилизаций, так и даже отдельных технологий требует учёта огромного количества факторов и, в настоящий момент, неосуществимо. В этой связи, для первых исследований, актуальны простейшие игровые модели мыслящей материи.

В статье рассматривается одна из таких компьютерных моделей, которая, тем не менее, способна отразить некоторые характерные особенности эволюции мыслящей материи, в частности, взрывной рост на определённом этапе, соответствующий предсказанной футурологами «технологической сингулярности».

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