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Innovative Trends in the Field of Modern Artificial Intelligence Methodology

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Abstract. **The article justifies the necessity of introducing methodological innovations in the modern field of artificial intelligence (AI), which precede and actively determine technological innovations. The authors of the article analyse the existing AI conceptual structure and point out its insufficiency and introduce significant improvements, including the figurative component. This addition was not made arbitrarily but in accordance with the structure of human natural intelligence, where the rational (symbolic) is directly related to the figurative and interacts with it. The figurative is not identical to the rational (symbolic); there are significant differences in their epistemological content. This difference results from the epistemological differences in their basic (primary) structures - the concept and the image. This, accordingly, means that the figurative (image) is always a reflection of the singular (individual), which is always brought to the sensory-specific, while the rational (concept) is always a reflection of the general (typical), which reaches the level of the systematic. This analysis of the peculiarities of the epistemological and methodological content of figurative and rational thinking becomes important not only in terms of studying the essence of an individual's natural thinking. These features are of great methodological importance in the modeling of artificial intelligence, especially when the question is raised about the creation of a new generation of artificial intelligent systems.**
Considering all of the above, artificial intelligence combines rational (logical) and figurative components, with priority given to the figurative structure as more information-intensive and heuristically powerful. It is the figurative component of artificial intelligence that defines and ensures the object's multidimensional representation, while the rational component chooses one of the dimensions provided by the figurative one and fills it with logical content. In the concept of functioning of a real artificial intelligence system, its figurative component initially functions, transforming into rational transformations, which, in turn, are later returned and included in more voluminous figurative architectures. The article proposes schemes that present new approaches to depicting the modern AI conceptual structure.
The suggested innovations are not implemented arbitrarily, they are determined and correspond to the real structure and functioning of human natural intelligence.
Keywords: artificial intelligence, methodology, artificial intelligence conceptual structure, modern model of artificial intelligence.

I. Introduction

The article justifies the necessity of introducing methodological innovations in the modern field of artificial intelligence (AI), which precede and actively determine technological innovations. The authors of the article analyse the existing AI conceptual structure and point out its insufficiency and introduce significant improvements, including the figurative component. This addition was not made arbitrarily but in accordance with the structure of human natural intelligence, where the rational (symbolic) is directly related to the figurative and interacts with it. The figurative is not identical to the rational (symbolic); there are significant differences in their epistemological content. This difference results from the epistemological differences in their basic (primary) structures - the concept and the image. This, accordingly,

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means that the figurative (image) is always a reflection of the singular (individual), which is always brought to the sensory-specific, while the rational (concept) is always a reflection of the general (typical), which reaches the level of the systematic. This analysis of the peculiarities of the epistemological and methodological content of figurative and rational thinking becomes important not only in terms of studying the essence of an individual's natural thinking. These features are of great methodological importance in the modeling of artificial intelligence, especially when the question is raised about the creation of a new generation of artificial intelligent systems.

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The suggested innovations are not implemented arbitrarily, they are determined and correspond to the real structure and functioning of human natural intelligence.

If we analyse the history of the various sciences, we can identify one interesting pattern: the vast majority of them at some point (one way or another) reach the level of analysing the methodological issues of their science. This is no coincidence because it is precisely with the reaching of such a stage that we consider its accomplishment of scientific maturity.

Moreover, discussions on methodological issues in a particular science usually take place when certain contradictions (or difficulties) arise, when complex scientific problems accumulate, and when an active search for their solution is underway. It is these problems that become fundamental, as they relate to and reflect the deep and meaningful context of a given science. As the analysis shows, all these processes gain positive significance, as they ultimately lead to the formation of new scientific theories and, in general, to progressive transformations of this science.

At the same time, other, no less important, transformations associated with technological changes in the relevant fields of science are also noteworthy. In fact, we can clearly state the direct cause-and-effect relationship between the concepts of "methodology" and "technology". The history of science and technology directly confirms that certain changes in technology are preceded by corresponding innovations in methodology. Moreover, methodological transformations not only precede, but, accordingly, powerfully determine the implementation of fundamental technological transformations. In other words, to make significant changes in the field of technology, it is necessary to seriously tackle methodology and ensure its significant innovation at the beginning.

Similar processes are currently taking place in the field of artificial intelligence. Methodological issues are being actively included in the context of scientific discussions of artificial intelligence specialists.

II. MATERIALS AND METHODS

Speaking about the current state and prospects of development of the artificial intelligence industry, it is worth noting the research of the famous American expert George Luger,[1] who, along with the issues of engineering technologies, highlights the need to address important methodological issues. When analysing certain limitations and disadvantages of the industry development, he sees them not so much in the shortcomings of scientific directions and schools of artificial intelligence research as in the limitations of philosophical and methodological nature. George Luger clearly and frankly points out that these limitations are conditioned by and derive from the philosophy of rationalism. This philosophical rationalism limits the development of artificial intelligence at the present stage. And if earlier the rationalist concept of physical symbolic systems was considered sufficient in general to characterise intelligence, then later and especially at the present stage, researchers began to argue that, on the contrary, the most important aspects of intelligence, in principle, cannot be modelled by means of symbolic representation. [2,3,4,5,6,7] George Luger pays special attention to the alternative methodological approach of the non-rational character.

In general, supporting the position of the American expert, it should be noted that today the entire field of artificial intelligence is entering a stage of fundamental transformation. The issue of developing a new generation of artificial intelligent systems that would function on completely new principles is on the agenda.

The main aim of the article is to substantiate the need for methodological innovations in the field of artificial intelligence sciences, as well as to develop new conceptual approaches that would serve as powerful methodological determinants of the development of a new generation of artificial intelligence systems.

Supporting the position of the leading American expert, we would like to express our views and suggest a non-rational concept of the figurative type of cognition, which would serve as a methodological basis for further innovations in the system of artificial intelligence modelling.

The main statements of this concept are presented by one of the authors in a scientific monograph [8], where a whole range of problems is considered and solutions to some of their main ones are proposed. However, the central idea that is substantiated is the need to develop a new general logic and methodology of figurative structures. This idea is seen as a kind of innovation in the system of modern general philosophical logic and methodology of scientific knowledge. It should be noted here that at the general paradigmatic level, the modern system of rational thinking is mainly provided and operates on the basis of logical and methodological structures. Figurative thinking on the general paradigmatic level is not supported at all in terms of logic and methodology. The logic and methodology of figurative

structures do not exist as such, they need to be developed. That is why we argue that the entire modern field of general scientific methodology is at the stage of radical transformation. Although in this regard there is a certain paradox when in the aspect of the general methodology of scientific knowledge only the question of the need to develop such a methodology is raised, and in the reality of scientific research in some fields elements of such a methodology have already been developed and are functioning to obtain new practical results.

Introduction The development of a new general methodology of figurative structures should be carried out taking into account the peculiarities of the primary, basic structure of figurative thinking - the image. Here it is necessary to point out the following fundamental pattern when the peculiarity of methodological functions is directly determined by the peculiarity of the gnoseological content of a particular form of cognition. This means that, if the basic structure of rational thinking is the conceptual form (concept), then, accordingly, the peculiarities of the gnoseological content of the concept determine the peculiarities of the methodological functions of rational structures. Accordingly, in identifying the features of the figurative methodology, one should proceed from the peculiarities of the gnoseological content of the image as the basic structure of figurative thinking.

The monograph [8] analyses the gnoseological content of both the image and the concept and points out their fundamental difference. If one thesis expresses the essence and content of these differences, then (in the author's opinion) it is legitimate to assert:

1. The figurative is a methodology of penetration into the individually specific, through the disclosure of the particular.
2. The conceptual (rational) is a methodology that ensures the achievement of the general through the reflection of the consistent.

These methodological features of the figurative and rational directly result from the peculiarities of the gnoseological content of their basic structures, which are expressed in the fact that the figurative (image) is always a reflection of the unit (individual), which is always brought to the sensory-specific, while the conceptual (concept) is always a reflection of the general (typical) that reaches the level of the consistent.

III. Results and Discussion

This analysis of the peculiarities of the gnoseological and methodological content of imaginative and rational thinking becomes important not only in terms of studying the essence of natural human thinking. These peculiarities are of great methodological importance in the field of artificial intelligence modelling, especially when it comes to creating a new generation of artificial intelligence systems.

Traditionally, artificial intelligent systems are based on the principle of inferential knowledge, when a person sets the machine's conceptual apparatus (forming its database) and provides the mathematical logic apparatus based on which one knowledge is derived from another. This is what we call the machine learning process. The new generation of image-based intelligent systems operates in a fundamentally different way: a person provides the machine with the ability to perceive sensory and imaginative data ("artificial senses"), and then the machine itself (without a person) develops sensory and figurative data, based on which the machine independently forms its knowledge base and uses it for its intended purpose. And this is quite different from teaching, it is a process of self-learning.

Thus, it is fundamentally important to model artificial intelligence of the figurative type:

- Provide the machine with the ability to independently sense perception.
- Hardware and software should be adjusted and developed to such a level that it allows the machine to independently develop sensory-imaginative material.
- The process of integrating new sensory-imaginative data is essentially a self-learning process, as a result of which the machine independently (without a human) forms its database.

Our opponent may have questions as if everything is not as simple as it is portrayed here. Firstly, how we can provide a machine with the ability to sense, what modern technologies (and whether they exist today) to use. The answer is that such technologies already exist, such as modern neurotechnology. However, they need to be used differently. In this regard, we would like to refer to the same American specialist George Luger [1], as well as to the above monograph, where these issues are also discussed [8]. Secondly, concerning the status of sensory and imaginative data that the machine will generate in terms of its scientific value and correlation with rational knowledge. And, thirdly, there is the no less important question of the motivation for the machine's functioning to obtain sense-figurative knowledge. The machine does not possess true motivation as such. Such motivation is brought in from the external world by a human being, which is determined by the system of human needs and interests. Therefore, the so-called machine motivation will be determined by the goals (setting of relevant tasks) that humans will generate.

We would like to emphasise the importance of this stage since it is at this stage that the main problems are solved (in fact, it becomes clear why a user engages a machine to perform certain intellectual functions). Accordingly, the main challenging task of the machine is to use the independently developed information and figurative basis (self-learning) to direct it to find a solution to the task set by a human. At least, if the existing information and figurative basis are not sufficient, the machine can independently "refine" it by supplementing its basis with new sensory and figurative information, until it is sufficient.

By performing these intellectual operations, the machine can provide several options for solving the tasks set by a human, ultimately determining one of the most effective ones. And let the human assess and make the final decision. If a person is not satisfied with the results provided by the machine, then they act as follows. It's not the machine that makes the decision, but the machine's

task is to form (in response to a human request) a certain sensory and figurative environment and let the person in. And let the person make the decision, to allow them to independently process figurative information, to visit the world of images.

Why it is so fundamentally important to provide a machine with the ability to artificially "perceive". There is only one explanation: an objective assessment of the importance of the role of human feelings in the functioning of human natural intelligence. We are acting by analogy, and this should be emphasized: what is important for human natural intelligence should be important for artificial intelligence. At the same time, objectively assessing the real gnoseological situation, we state a certain paradox, which is expressed in the underestimation of the role of the sensory component not only in the process of cognition but also in human life support in general. We will dwell on what is meant by this in further detail. There are classical statements that human feelings are an objective source of knowledge, a direct form of reality reflection. That is, a person is directly connected with the objective world through their feelings. At the same time, feelings themselves do not seem to provide knowledge but are a kind of gnoseological background for this knowledge. After all, sensory data must be rationally processed, and only then can the transformation and formation of scientific knowledge itself take place.

All of the above statements relate to a purely rationalistic interpretation of the process of cognition, the main point of which is that without the rational there is no knowledge and no cognition itself. But let us critically review the above rationalist position and categorically state that in order to acquire the status of knowledge, the presence and function of rational structures of human thinking are not necessary. Even without the rational component at the level of sensory-figurative knowledge, knowledge can also be formed and not only formed but also actively heuristically function.

Therefore, we would like to point out the misconception of rationalism that sensory-imaginative data do not acquire the status of knowledge. We believe that it is legitimate to argue that sensory-imaginative knowledge also provides a level of scientific knowledge, but even more information-intensive and heuristically powerful. In this matter, there is an objective problem of revising the criteria of scientific knowledge, which need to be significantly enhanced, not limited to rationalistic criteria. It is this formulation of the issue that leads us to a more global problem, namely: what kind of science should be in the future, and what transformations it can undergo in the short and long term.

- However, we shall return to the initial problems concerning the acquisition of the scientific status of sensory and figurative knowledge and its relationship with rational knowledge. We have already considered such issues (in this particular formulation) in our previous research [8].
- Summarising this analysis, we believe it is reasonable to say that this refers to the functioning of natural human thinking:
- Rational and figurative knowledge should be considered as parity (equivalent). And most importantly, in their interconnection and close integration.
- Sensory and figurative knowledge is the initial one, which sets a certain strategy for scientific research. This strategy is determined by the multidimensionality of sensory and imaginative knowledge, which reflects the limitless range of sensory and imaginative data obtained.
- The multidimensionality of sensory and figurative data is determined by the social coordinate, which reflects and functions on the principle of social expediency (based on human interests and needs). And since the interests (needs) of people differ, this, accordingly, determines a variety of social certainty, which is imposed as a matrix and sets the social request to which the sensory-imaginative should respond (and find an answer).
- The sensual and figurative then turns the baton over to the rational, which chooses one (the most reasonable choice at a given historical stage) from the many dimensions and fills it in based on the results of the preparatory work, guided by the logical component. As soon as this one-dimensional choice has been logically completed, the rational returns to the sensory-figurative to include its one-dimensional choice (already filled with logical content) in the sensually chosen multidimensional choice and to "show" its results in the context of social expediency.

However, the rational does not stop at this point, but again, interacting with the multidimensionality of the sensory and figurative chooses another new choice in order to repeat the gnoseological procedure (logical "filling" of this choice) and return to the original (sensory and figurative). And such a path of the rational is a demonstration of its higher purpose and sense of existence.

If these questions are brought to the level of paradigmatic assessments, then, to summarise, we will point out that the status of the figurative structures of natural human thinking is gaining special significance. That is why the essence of paradigm shifts is not so much in the modernisation of rationality itself as in the transformation of forms of rationality and their further inclusion in the basic structures of a more voluminous figurative world perception. We have already considered such a dialectic of the transition of the figurative to the rational in our previous research [8].

The mentioned mechanism, we emphasise once again, of functioning and interaction between rational thinking and figurative thinking is implemented in the system of human natural intelligence. At the same time, this should be emphasised again, in addressing the issues of artificial intelligence modelling, it is necessary to act by analogy and achieve similar results. This means that, based on the methodological approach to the analysis of the structure, content and functions of human natural intelligence, the solution to the problem of modelling artificial intelligence becomes somewhat multidimensional and complex. This problem cannot be solved (by and large) by creating a single character of an artificial intelligent system that would simply be capable of performing certain symbolic intellectual operations. Such artificial intelligent systems

of a singular character can be modelled infinitely (by adapting them to perform relevant practical tasks). Of course, this is also important in the local dimension. In principle, if we limit ourselves to this kind of modelling (in general), the problem of artificial intelligence may never be solved. The proposed above methodological representation and model of natural human intelligence in the form of a complex hierarchy of figurative and rational, especially and necessarily requires fundamentally different methodological approaches to solving the problem of modelling artificial intelligence and its structure. The main aspect of such new methodological approaches is expressed in the form of representing such an artificial intelligence structure as a single, complex, hierarchical artificial intelligence system (by analogy with natural intelligence). Accordingly, two structural levels can be distinguished here: the first (more voluminous), which is presented in the form of artificial sensory and figurative structures; and the second (of lesser content) - artificial symbolic structures of the intellectual system. We think that in the presentation and construction of the most complex structure of artificial intelligence, it is necessary to rely on and be guided by (and it is created for this purpose) the principles of the already existing technology of parallel-hierarchical networks. Where one level of the hierarchy represents, accordingly, the figurative structure as a single whole, which, at the same time, is differentiated into many corresponding (smaller) structural components, which are provided by many series of symbolic calculations. Accordingly, there can be several or many such levels (figurative structures), each of which is provided by a symbolic series according to its structure and content. At the same time, in turn, the identified levels can be integrated into a new (more voluminous) figurative architecture. Such integration (ultimately) is carried out according to the criteria of the target settings received by an artificial intelligent system from a human.

Therefore, having presented the structure of artificial intelligence as a complexly organised parallel-hierarchical system, the issues of developing the latest approaches to the element base and hardware of a new type of intelligent structures are consequently becoming relevant. In this case, we can appeal to another of the modern information technologies - neurotechnology, which allows us to solve the extremely difficult task (in our opinion) of modelling the sensory imagery component. Since (and here we will refer to the authority) it is the American specialist George Luger who claims that it is an artificial neural network that, if properly trained, reveals its ability to sensory perception [1].

Accordingly, it is justified to use other already existing and well-proven information technologies, such as parallel-hierarchical networks [9] and optical technologies, but with their prior re-profiling to perform fundamentally different tasks. Moreover, at the same time, actively begin to develop new technologies, taking into account their specifics for the functioning of a complex hierarchical intelligent system.

However, the main thing that needs to be pointed out here is that conducting such studies requires a fundamentally new approach to solving complex problems, especially in the context of studying such a component as figurative thinking. In our opinion, here we need to turn to the already developed methods and technologies in the system of other modern sciences (in particular, optical science).

The proposed artificial intelligence architecture is presented in the form of a complex multi-level parallel hierarchical network with its priorities. Everything is carried out following the structure and functions of natural intelligence, where, by analogy, such priorities take the following form and are as follows:

1. The figurative and rational components of artificial intelligence are considered in their interrelation and mutual transition to each other.
2. The figurative components are presented in the form of certain levels (of a more voluminous nature), which are provided by the corresponding (smaller) series of symbolic structures.
3. Sensual and figurative components have one significant advantage - its social determination, it directly " glows " with the social. Whereas the rational has no direct connection with the social, but is related to it indirectly - through the sensual and figurative.
4. Therefore, the rational, in order not to lose its connection with the socially appropriate, needs (and it has no other option) to constantly connect with the sensual and figurative. Actually, not with the sensual and figurative in general, but with the socially expressed multidimensionality which it provides, in order to take one of these dimensions and (based on the results of the preparatory work) fill it with logical content. And then, without stopping at this, to return to the initial point (to the multidimensionality of the sensory-figurative) and to include this one dimension (but already filled, socially grounded) in a single sensory-figurative multi-dimension. Then (having fulfilled its relatively finite function), it repeats it, taking another (second) dimension as a basis. Thus, the social multidimensionality of the sensory and figurative component of artificial intelligence can be continued endlessly.
5. It is clear that human sensory-figurative natural thinking objectively directly reflects (and is filled with) social content. As for sensory-figurative artificial intelligence, the social is not given to it by itself but is introduced by the person himself in the form of certain social attitudes (specifically set tasks) that the person gives to the machine. As for the social coordinates for rationality, in any case (whether in natural or artificial intelligence), they are obtained indirectly and, necessarily, through the sensory-figurative.

Innovative model of artificial intelligence (AI) Common structure of artificial intelligence (AI) we have stated) the sensory and figurative are directly related to and reflect the components of the social and to what extent the components of the social are the dominant factor in the process of modelling artificial intelligence.

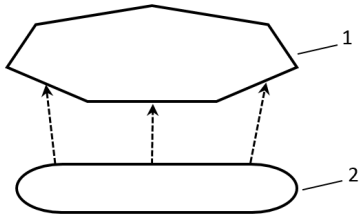

Fig. 1. Figurative structure of AI (figurative picture of the world)

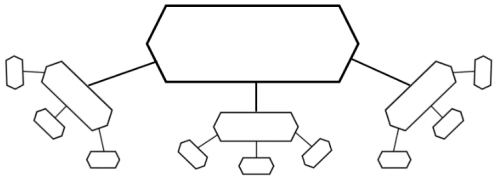

Fig. 2. Rational structure of AI (scientific picture of the world)

The answers to these questions stem from the general understanding that artificial intelligence development is not the goal itself (intelligence is not for the sake of intelligence), but the ultimate goal is its inclusion in the context of social practice (i.e., the human aspect). If social factors are conditionally removed, then, accordingly, any sense of modelling and functioning of artificial intelligence is lost.

However, why, it is in the sensory and figurative that the social dimension finds its greatest manifestation. Here we need to proceed from the general philosophical provisions about the sensual essence of a human being. A human being is first and foremost a sensual creature, and the sensual component is the first, and then the rational component is added. The sensual nature of man stems from his material nature (carnal basis). That is why social factors acquire, first of all, material and then (at the next stage) spiritual social needs, which are expressed and provided in sensory and figurative forms.

CONCLUSIONS

In general, it is true to say that no matter how high the level of artificial intelligence is, it is unable to reach or even replicate the level of natural human intelligence. Artificial intelligence is doomed to always be the "second" one. And this is not only in the context of artificial intelligence becoming helpless without humans, expecting appropriate social targets from them. Here, it is necessary to point out another global, even more powerful (than the sensory-figurative and rational) component of human intelligence, namely intuitive thinking. So far, we have not mentioned intuition. However, it is with intuition that we associate the realisation of the highest level of human intelligence. However, (without revealing the content of this component yet) we point out that intuition is a component of human natural intelligence. Is artificial intelligence capable of acquiring the ability to think intuitively? Let's leave this question open for now.

Thus, summarising and generalising all the above material, it is fair to draw the following general conclusion. Methodological innovations in the structure of artificial intelligence are extremely necessary and important. They are a condition for and a significant factor in further technological innovations in the field of artificial intelligence. Shifting the emphasis on the structure of artificial intelligence towards the dominance of figurative components and their corresponding hardware and software content is a prerequisite for modelling a new generation of irrational artificial intelligence systems. All this allows the entire field of artificial intelligence to reach a higher level.

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