

ABSTRACT

to the thesis research, submitted for the PhD degree in specialty 6D071900 –
«Radio engineering, electronics and telecommunications» by

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A subject of this thesis paper:

Development of theoretical bases of methods of counteraction to modern
forms of information warfare

Currently, there is a steady trend towards the integration of information and telecommunication technologies. The term information and communication technologies has also become widespread. The further development of both the above scientific and technical areas, and the development of technologies emerging at their junction, are increasingly influenced by artificial intelligence systems. This influence is mutual. On the one hand, artificial intelligence systems, penetrating the telecommunications sector, make it possible to improve many technologies that previously belonged exclusively to the telecommunications sector. It is essential that artificial intelligence systems make it possible to radically change the nature of data transmission in telecommunication networks, which is also more and more clearly seen in practice.

At first glance, it may seem that the telecommunications sector is influenced by information technology, and the reverse effect is somewhat less pronounced. This paper shows that this is far from being the case, that the telecommunications sector is also capable of significantly influencing the development of information technology.

To comprehend the essence of intelligence, it is important to analyze exactly how information is exchanged in society. And it is here that the key role of the telecommunications sector at the present stage is manifested. This is due to the fact that in modern conditions it is possible to track, moreover, in large numbers, the nature of interpersonal communications, which more and more fall on telephone conversations, messages in instant messengers, letters on the Internet, and so on. This gives rise to a well-defined logical structure of a new approach for the creation of superintelligent systems, and it is entirely based on research in the field of telecommunications.

In order to substantiate the provisions of dialectical positivism, which reveal the essence of intelligence, it is important to follow the telecommunications sphere. Of course, the practical implementation of super-strong artificial intelligence systems is still quite far away, and the solution of this problem cannot be the subject of a separate dissertation work. However, there is a very specific area of application for those ideas that are associated with the development of superstrong artificial intelligence systems and which this work develops. Specifically, we are talking about significant transformations that have occurred in all those areas of human activity that are somehow connected with information wars. This paper proves that

the toolkit of information wars has undergone more than serious changes over the past century and a half, and today the main and most effective tools for conducting information wars lie in the border area at the intersection of sociology, psychology, telecommunications and information technologies.

The target of the most effective tools of information warfare is the socio-cultural code of those countries that become the targets of attacks. Therefore, in order to effectively counteract them in order to ensure the resistance of society to such tools, it is necessary, first of all, to understand the mechanisms of the formation of a socio-cultural code, and here modern possibilities for studying the telecommunications environment also provide more than serious chances.

But in order to really go in this direction, you first need to understand the essence of intelligence and substantiate the fact that it is a specific feature at the level of quantitative theories. This problem is also solved in this work.

Specific studies related to the issues of information warfare were carried out in it, including on the basis of an analysis of the state of affairs in the scientific and pedagogical sphere. It is appropriate to emphasize that it is precisely in the scientific, technical and educational sphere that the geopolitical confrontation is shifting more and more clearly. In a sense, history is returning to square one: in the 21st century, geopolitical confrontation will again fall on the scientific and technical sphere, just as it happened in the middle of the 20th century. There is, however, an essential nuance - this confrontation is closely related to the confrontation in the field of higher education, and here the problem of understanding the essence of such seemingly far from the sphere of telecommunications categories as mass consciousness, the collective unconscious, the sociocultural code, as well as public consciousness become extremely important.

The purpose of the dissertation work is to develop the theoretical foundations for studying the global communication environment as a human-machine system based on overcoming the logical opacity of neural networks and substantiating the possibility of their application to the development of methods to counter modern information warfare technologies in the scientific and technical field.

The main tasks of the work:

1. Proof of the possibility of describing a human-machine system resulting from the interaction of society with modern telecommunication systems based on the analogy with neural networks.
2. Establishing a connection between the methods of error-correcting coding and the theory of neural networks, proving the methodological equivalence of the tasks they solve.
3. Formulation and proof of theorems describing the behavior of neural networks with a threshold activation function based on the ideas of projective geometry in order to overcome the logical opacity of neural networks.
4. Establishing the possibility of reducing arbitrary neural networks with a threshold activation function to logical elements
5. Experimental establishment of patterns that reflect the behavior of the global communication network based on the analysis of data on the

statistics of telephone conversations of subscribers of mobile networks and statistics that reflect the behavior of users of social online networks.

6. Analysis of risk factors for exposure of the scientific and technical sphere of the Republic of Kazakhstan to modern information impacts and justification for the need to develop methods to counter them.

The scientific novelty of the dissertation work is that:

- the interpretation of the human-machine system, which is formed as a result of the interaction of society with modern telecommunication systems, is proposed, based on the analogy with neural networks;
- the thesis about the logical opacity of artificial neural networks was overcome by comparing their work with noise-immune coding;
- using the ideas of projective geometry, it is proved that the weight coefficients of neural networks with a threshold activation function can be selected from a certain discrete set (-1 and 1);
- proposed neural networks that do not require a procedure for setting weights, and ensure the performance of specified functions by creating a certain structure of connections between elements that perform the function of a scalar product;
- an empirical formula has been established that experimentally proves the existence of quantitative patterns inherent in the global communication environment, based on an analysis of the behavior of users of social online networks and statistics of telephone conversations between users of mobile networks;
- the existence of a tool for conducting information warfare through the impact on the structure of the communication space is revealed and it is shown that this tool becomes the most effective in relation to the scientific and educational space.

Credibility of work. The reliability of the results of the work is confirmed by the following factors

- correspondence of experimental and theoretical results, moreover, experimental results were obtained on heterogeneous factual material (statistics of telephone conversations and statistics reflecting the behavior of users of social online networks);
- experimental study of neural networks implemented using widely used simulation tools, and proving that the proposed interpretation of the concept of "neural network" is really adequate, in particular, such neural networks solve the same problems as noise-correcting coding methods;
- coincidence of theoretical results obtained by different methods and their internal consistency.

The following provisions are put forward for defense:

- substantiation of the existence of a global communication environment, formed through the integration of society and telecommunication systems based on analogy with neural networks;
- the concept of neural networks without custom weights;
- interpretation of the functioning of neural networks by analogy with noise-immune coding;

- the existence of objective patterns describing the global telecommunications environment, established on the basis of an analysis of experimental material related to the field of telecommunications;

- the need to counteract modern tools of information warfare in the scientific and educational sphere, associated with a directed impact on the communication structure of this segment of society.

The practical value of the work consists in:

- creation of new approaches to the directed synthesis of neural networks with predetermined properties, proven on the basis of a comparison of the theory of neural networks and methods of error-correcting coding;

- ensuring the possibility of counteracting modern tools of information warfare in the scientific and educational sphere.

Approbation of the results of the dissertation. The main provisions of the work are presented in 37 publications, including 10 in publications recommended by the KKSON MES RK, including in journals included in the Scopus database (among them the Journal of Theoretical and Applied Information Technology, percentile - 36), in 14 international scientific-practical conferences, schools-seminars and symposiums held in Almaty, Nur-Sultan, Moscow, St. Petersburg, Sevastopol, Antalya, Shanghai, San Francisco, as well as 3 monographs were published.

The author's personal contribution consists of:

- in conducting a comparative analysis, generalization and critical analysis of literature data;

- in proving the theorems contained in the dissertation and carrying out all calculations;

- in the collection of factual material and its processing by numerical methods;

- in the interpretation of the results obtained.

Volume and structure. The dissertation contains normative references, designations and abbreviations introduction, 4 sections, conclusion, list of references, 3 appendices. The dissertation is presented on 180 pages of a computer set, including 82 figures and 7 tables, 176 formulas, a bibliography of 152 titles.

In the introduction, the relevance of the research problem is substantiated, a general description of the research area is presented, the purpose and objectives of the research are formulated, the scientific novelty and practical significance of the dissertation work are described, and the provisions submitted for defense are formulated.

The first chapter analyzes the existing approaches to the interpretation of such concepts as neural network and intelligence. The emphasis is on the fact that in modern conditions, in connection with developments in the field of artificial intelligence systems, these concepts, or rather their methodological basis, should be considered as something interconnected. The same chapter discusses the methodological foundations for a fundamentally new interpretation of the concept of intelligence. It is proved that the concept of "intelligence" cannot be revealed on a purely descriptive basis (as is the case in modern literature). It is shown that the essence of intelligence can be revealed on the basis of the principle of dialectical symmetry, which, in particular, refers to the symmetry between the categories of

matter and information, which are considered as paired within the framework of the philosophy of dialectical positivism. It is proved that such an approach is the basis for creating systems of super-strong intelligence, firstly, and, secondly, it is this approach that allows us to proceed to the consideration of the global communication environment as an integral object that obeys well-defined patterns.

In the second chapter, mathematical proofs are given that the proposed approach is not only correct from the point of view of general methodology, but has quite definite advantages from the point of view of further development of the theory of neural networks. In particular, this section proves that, strictly speaking, there is no difference between such an object as a neural network and those procedures that are considered in error-correcting coding methods. It is proved that these two scientific directions, in essence, solve the same problem. At the same time, analogues of neural networks are built, which allow decoding the classical Hamming code. Verification of the obtained results on simulation models is provided. It is proved that the concept of a neural network should be substantially revised due to both purely applied considerations and those considerations that follow from general methodological considerations.

In the third chapter, basic theorems are proved that make it possible to radically revise the content of the concept of "neural network". It is proved that for further convergence of artificial neural networks and those that are implemented in nature, it is necessary to abandon the idea of adjustable weight coefficients, and move on to the consideration of neural networks, in which the signals intended for processing by the network and the signals that provide what replaces weighting factors should be considered in terms of methodological symmetry.

In the fourth chapter, experimental evidence of the validity of the developed approach is given. These experimental evidences are given based on the analysis of statistical patterns describing the behavior of users of social online networks, as well as on the basis of statistical patterns describing the distribution of telephone conversations by duration. The analysis of risk factors for exposure of the scientific and technical sphere of the Republic of Kazakhstan to modern information influences and the rationale for the need to develop methods to counter them.