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DEVELOPMENT OF METHODS FOR PHYSICAL AND MATHEMATICAL MODELING OF COMPLEX SYSTEMS

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Abstract. The paper investigates the theoretical aspects of the development and modernization of physical and mathematical modeling methods to improve the quality of functioning of complex systems. Taking into account the disadvantages and advantages of these mathematical models and methods, a list of areas of their possible application is proposed.

Physical and mathematical modeling is a powerful tool for solving applied engineering problems. The prerequisites for modern achievements in scientific and technological progress are the development of applied mathematical models and the improvement of existing methods of physical and mathematical modeling to improve the quality of automation of complex systems design. Optimization of control processes of complex systems is based on the use of physical and mathematical models and computational methods for their implementation, which involves the study of processes and phenomena of physical nature based on mathematical relationships.

With the development of modern technologies (artificial intelligence, biotechnology, digitalization and digitalization processes), the use of physical and mathematical models and computational methods in interdisciplinary scientific fields is becoming increasingly popular. Among the mathematical models for the calculation and optimization of a number of complex systems, we highlight the following:

- when choosing the optimal mode of operation of a transportation system, a mathematical model based on the Doppler effect is often used. This allows to take into account data for filtering mathematical models and building ROC curves. At the same time, improving the quality of the transport system is achieved by optimizing the energy and time spent on cargo transportation. This allows to reduce the load on individual links and the transport system as a whole by optimizing the movement of vehicles and choosing the optimal routes for the transportation of goods [1];
- mathematical models of parallel computing of complex cyber-physical systems for modeling and identifying high-performance technologies in the presence of a significant number of feedbacks and interaction of a network of computing elements. The computational structures for implementing the calculation and optimization of the objective function parameters are built taking into account the algorithms of multi-parameter regularization to identify the parameters of the modeled system [2];
- applied optimization mathematical models used to calculate and optimize the parameters of technical and biotechnological systems under the influence of thermal

load sources. By applying algorithms constructed using specialized methods from the theory of pseudo-differential operators, the existence of a single solution to boundary value problems for systems of differential heat conduction equations modeling the processes of thermal loading in these systems is substantiated [3].

Thus, the development of new and improvement of existing applied optimization mathematical models and computational methods for implementing the processes of searching and searching for local extrema of the objective function to find the most optimal values of the selected parameters is an integral part of improving the quality of functioning of technical, biotechnological, transport and other systems. Determination and justification of the conditions for the correctness of boundary value problems allows to increase the accuracy of the search process of local extremes by increasing the accuracy of the formalization of boundary value problems in mathematical modeling.

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