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ARTIFICIAL INTELLIGENCE TOOLS FOR ANALYZING CYBER-PHYSICAL SYSTEMS

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The work examines the main concepts of the use of artificial intelligence tools in order to increase the accuracy of the implementation of applied mathematical models for cyber-physical systems. Among the above concepts, the concept of increasing the detail of simulated systems should be singled out. Despite the fact that this will complicate the mathematical modeling of cyber-physical systems, in addition, the accuracy of the calculation and optimization of the parameters of the modeled systems will increase due to the solution of modernized mathematical models.

The rapid development of artificial intelligence is modernizing search technologies, data processing and systematization processes, programming systems, machine learning, robotics, and technology modeling, which have the latest research methods and terminology. In addition, artificial intelligence technologies influence the development of mathematical modeling of processes based on the latest methods of solving problems related to coding knowledge about existing problems to create more adaptive and flexible models and interpretation of results. In this case, the use of artificial intelligence will provide a high degree of realization of numerical models and effective solutions, which leads to the creation of easier-to-write and more adaptable codes of computing equipment. The various search, mathematical planning, and reasoning algorithms will design effective mechanisms for solving problems related to the construction of a model based on constraints [1, S. 11–20].

Currently, mathematical modeling is the simulation of a physical phenomenon using computing processes and technologies, which makes it possible to predict the behavior of a certain phenomenon in a certain environment. The influence of artificial intelligence technologies modernizes mathematical modeling, creates a new interpretation of numerical results, and develops numerical algorithms. In this case, it is necessary to consider more advanced concepts in terms of considering the specifics of the modeled processes that modernize traditional mathematical modeling:

1) generating models of cyber-physical systems is used to define actions that build models suitable for computer software, create models with a wide range of phenomena, considering various algorithms of conceptual research (automated analysis of production processes, finished components, structures and systems themselves). Thus, there is a need to minimize the analysis process, which will allow generating models with multi-vector behavioral actions, which increases their quality, reliability, and analysis performance;

2) model interpretation and validation are used to verify the selected model in

operations after analysis, abstraction, and response assessment, as well as to consider proposals for redesigning the state of the modeled cyber-physical system (the generated system model using the method of a set of probable assumptions can be traced back to the assumptions, considering the verification of the conditions for their validity) [2, Pp. 753–776];

3) abstraction and assessment of the conformity of numerical results – creation of an abstract description of numerical results, considering the parameters of model behavior obtained as a result of the analysis. Thus, obtaining meaningful aggregate values depends on knowledge of the characteristics and ability to capture functional information that goes beyond the properties of the modeled cyber-physical system and depends on its functional nature (computer vision and action analysis interpretation methods);

4) complex modeling processes - the combination of symbolic computing and numerical methods has led to the emergence of innovative computational tools for use in analysis (numerical methods of function minimization and reasoning methods with the use of artificial intelligence tools are used to effectively solve nonlinear problems). Thus, new modeling tools and approaches can significantly expand and save resources for problem-dependent aspects of cyber-physical systems [3, S. 190–194].

Mathematical modeling and the development of artificial intelligence are always inextricably linked. This combination creates new mathematical models for analyzing and making plausible assumptions, establishing the relationship between information for more efficient use and making informed strategic decisions (predicting potential risks in the future and building models of physical object behavior), visualizing and transforming traditional practices. This will make it possible to anticipate and instantly respond to changes and uncertainties in a cyber-physical system in advance, detect and eliminate anomalies, and increase the stability of the modeled system. Today, mathematical modeling with the use of artificial intelligence technologies will provide new methods for solving problems in cyber-physical systems and will facilitate a detailed study of their development.

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