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Basic concepts of computer modeling, their features and properties

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Annotation:
Approaches to the construction of computer models are considered. Information analysis showed that when building models, the following are important: the balance of errors of various types, the multivariance of implementations of model elements, conducting a limited experiment on the system itself, using an analogue and analyzing the initial data.

The improvement of information technology has led to the use of computers in almost all spheres of human activity. The development of scientific theories presupposes the advancement of basic principles, the construction of a mathematical model of the object of knowledge, and the derivation of consequences from it that can be compared with the results of an experiment.

The use of a computer makes it possible, on the basis of mathematical equations, to calculate the behavior of the system under study under certain conditions. Often this is the only way to get consequences from a mathematical model.

For example, the problem of the motion of three or more particles interacting with each other is relevant in the study of the motion of planets, asteroids, and other celestial bodies. In the general case, it is complex and does not have an analytical solution, and only the use of the computer simulation method makes it possible to calculate the state of the system at subsequent points in time [1]. The solution of modern problems requires the creation of computer models, a huge amount of calculations, which became possible only after the appearance of electronic computers capable of performing millions of operations per second. It is also essential that the calculations are performed automatically, in accordance with a given algorithm, and do not require human intervention. To date, computer modeling methods have become so widespread that there is practically no scientific area left where these methods have not found their personal professional application.

Moreover, computer simulation as a research tool has a number of advantages compared to a real experiment, in particular, a computer experiment can be performed under conditions where it is difficult or even impossible to conduct a full-scale experiment. The principles define the general requirements that a well-built model must satisfy. Let's look at these complex general principles.

1. Adequacy. This principle provides for the conformity of the model to the objectives of the study in terms of complexity and organization, as well as the conformity of the real system with respect to the selected set of properties. Until the question of whether the model correctly displays the system under study is resolved, the value of the model is negligible.

2. Correspondence of the model to the problem being solved. The model should be built to solve a certain class of problems or a specific problem of studying the system. Attempts to create a universal model aimed at solving a large number of various problems lead to such complication that it turns out to be practically unusable. Experience shows that when solving each specific problem, you need to have your own model that reflects those aspects of the system that are most important in this problem. This principle is related to the principle of adequacy.

3. Simplification while maintaining the essential properties of the system. The model should be simpler than the prototype in some respects that is the point of modeling. The more complex the system under consideration, the more simplified, if possible, its description should be, deliberately exaggerating typical ones and ignoring less essential properties. This principle can be called the principle of abstraction from secondary detected nessecary details.

4. Correspondence between the required accuracy of the simulation results and the complexity of the model. Models by their nature are always approximate. The question arises. what should be the approximation. On the one hand, to reflect all any significant properties, the model must be detailed. On the other hand, it is obvious to build a model approaching the complexity of a real system. doesn't make sense. It should

not be so complex that finding a solution is too difficult. A compromise between these two requirements is often achieved through trial and error. Practical recommendations for reducing the complexity of models are:

– change in the number of variables, achieved either by eliminating irrelevant variables or by combining them. The process of transforming a model into a model with fewer variables or constraints is called aggregation. For example, all types of computers in the model of heterogeneous networks can be combined into four types – PCs, workstations. large computers (mainframes), cluster computers;

– changing the nature of variable parameters. Variable parameters are considered as constants, discrete ones as continuous, etc. So, for simplicity, the propagation conditions of radio waves in the radio channel model can be taken constant;

– change of functional dependence between variables. The nonlinear dependence is usually replaced by a linear one, the discrete probability distribution function is replaced by a continuous one;

– changing restrictions (adding, deleting or modifying). When restrictions are removed, an optimistic solution is obtained, when introduced, a pessimistic one. By varying the constraints, it is possible to find possible boundary values of efficiency. This technique is often used to find preliminary estimates of the effectiveness of solutions at the stage of setting logically properly tasks;

– model accuracy limitation. The accuracy of the model results cannot be higher than the accuracy of the original data.

5. Balance of errors of various types. In accordance with the principle of balance, it is necessary to achieve, for example. balance of the systematic error of modeling due to the deviation of the model from the original and the error of the initial data, the accuracy of individual elements of the model, the systematic error of modeling and the random error in interpreting and averaging the results.

6. Multivariance of implementations of model elements. A variety of implementations of the same element, differing in accuracy (and, consequently, in complexity), ensures the regulation of the "accuracy-complexity" ratio value.

7. Block structure. If the principle of the block structure is observed, the development of complex models is facilitated and it becomes possible to use the accumulated experience and ready-made blocks with min-

imal connections between them. The allocation of blocks is carried out taking into account the division of the model into stages and modes of operation of the system. For example, when building a model. For a radio reconnaissance system, one can single out a model for the operation of emitters, a model for detecting emitters, a direction finding model, etc.

Depending on the specific situation, the following approaches to building models are possible:

– direct analysis of the functioning of the system;
– carrying out a limited experiment on the system itself;
– use of analogue;
– analysis of initial data.

There are a number of systems that allow direct research to identify significant parameters and relationships between them. Then either known mathematical models are applied, or they are modified, or a new model is proposed. Thus, for example, it is possible to develop a model for the direction of communication in peacetime. During the experiment, a significant part of the essential parameters and their influence on the efficiency of the system are revealed. Such a goal is pursued, for example, by all command post games and most exercises. If the method of constructing a system model is not clear, but its structure is obvious, then you can use the similarity of a simpler system for which a model could easily exists in these conditions.

You can start building a model based on the analysis of initial data that are already known or can be obtained. The analysis allows us to formulate a hypothesis about the structure of the system, which is then tested. This is how the first models of a new model of foreign technology appear in the presence of preliminary data on their technical parameters.

Modelers are under the influence of two mutually contradictory tendencies: the desire for completeness of description and the desire to obtain the required results by the simplest possible means. A compromise is usually reached along the path of building a series of models, starting from extremely simple and ascending to high complexity (there is a well-known rule: start with simple models, and then complicate). Simple models help to better understand the problem under study. Complicated models are used to analyze the influence of various factors on the simulation results. Such an analysis allows excluding some factors from consideration.Complex systems require the development of a whole hierarchy of models that differ in the level of displayed operations. Allocate such levels as the whole system, subsystems, control objects, etc.

Literature

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Принципы построения интеллектуальных систем

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Аннотация:
В данной статье рассмотрены компоненты и принципы построения современных интеллектуальных системах.

Интеллектуальные системы проникают во все сферы нашей жизни, поэтому становятся неотъемлемым элементом при решении задач автоматизации и управления сложными объектами.

Современное понятие **интеллектуальных систем** сформировалось в процессе развития теоретических основ кибернетики, теории алгоритмов, развития современных информационных технологий, методов и средств в области искусственного интеллекта.

Интеллектуальной считается система, обеспечивающая решение неформализованных задач в некоторой предметной области и организующая его взаимодействие с компьютером в привычных понятиях, терминах, образах.