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# THE MAIN POSITIONS OF THE CONSTRUCTION OF POLYARGUMENT SYSTEMS METHODS FOR SOLVING MULTIDIMENSIONAL PROBLEMS OF TRANSFER

***Summary.*** *The main positions on which the construction of methods of polyargument systems is based are considered. Highlights the most important features of various modifications of these methods.*

***Key words:*** *multidimensional transport tasks, mathematical modeling, computational efficiency.*

The use of different projection and variation methods for solving complex multidimensional transport problems is associated, as is known, with a number of difficulties. When constructing these methods some a priori functional information - the system of so-called basic functions appearing in the form of a solution representation, and other functions used to take into account the configuration of the area in question and boundary conditions are introduced. When an unsuccessful choice of these functions, there are known difficulties associated with the deterioration of the conditionality of the corresponding systems, poor convergence of the solution, etc. Thus, the further development of projection and variational methods in the direction of creating a special class of methods, in which is absent of the need to use a priori functional information in construction of these methods, is relevant. According to the latter, these methods have high adaptive properties with respect to the factor of multidimensionality, which leads to their high computational efficiency [1, p. 2; 2, p. 60-61; 3, p. 295].

This paper discusses the main theses, on which the construction of polyargument systems methods (MPS) is based, and the most important features of different modifications of these methods.

The following three theses were proposed as the basis for the construction of the MPS:

1. The desire to eliminate the need to use in the desired solution of any a priori elements and to determine as much as possible all the information required for the construction of the solution, based only on the given mathematical formulation of the problem.

2. The completeness of the functional reflection of the initial information in the reduced task.

3. Reduction of a multidimensional problem to special one-dimensional tasks.

The first thesis concerns the exclusion of such a priori elements, such as, first of all, the basic functions and some additional functions that ensure the fulfillment of the boundary conditions, area shape accounting ets. As for the second thesis, it is a requirement to have the opportunity in the process of reduction the information appearing in the original mathematical model in a functional form, reflect in a reduced formulation also in a functional form. The third thesis is motivated by the need to have a well-developed mathematical apparatus that can be effectively applied to the solution of the considered problem.

The unity of all methods of the class under consideration is determined by the subordination of each of them to the formulated initial theses, and above all to the requirements of the concept of completeness of functional reflection. The variety of methods is determined by the differences that occur when implementing the noted initial theses. Two types of such differences can be pointed out: the first type is related to the different degrees of actual implementation of indicated theses; the second type of differences is due to the possibility of using different tools in implementation of these theses.

The differences of the first type give rise to two main subclasses of MPS - the methods of complete polyargument systems and the methods of incomplete polyargument systems. The construction of methods of complete polyargument systems is due to the desire to implement the concept of completeness of functional reflection to the greatest extent. In this case, the number of special one-dimensional tasks that make up the reduced task (p-system) must always be equal to the dimension of the original multidimensional task. At the same time, which is especially important, all components of the original mathematical formulation without exception in all directions of coordinates are covered by functional reflection, that is, the requirements for the componential and the structural completeness of functional reflection are fully implemented. The possibility, however, and even in some practical situations, the desirability of reflecting in a functional form not all the initial information, but only some of its most essential part, creates a subclass of methods of incomplete polyargument systems. In this subclass, only partial reflection of the initial information in a functional form is realized. The number of singular one-dimensional tasks in the p-system here may not be equal to the dimension of the multidimensional task.

The above differences of the second type (associated with the use of different means of implementing the initial theses) lead to the possibility of constructing many further modifications of the MPS. This possibility lies primarily in the diversity of the applied forms of representation of the desired solution, underlying the relevant subclasses of methods, for example, direct and recurrent.

Along with the solution presentation form, another source of a variety of methods is the reduced procedure. Use as a procedure for reducing the integration operation with weight, fixing the coordinates or combined application of these operations leads, respectively, to integral MPS, coordinate lattice methods, combined (integro-collocation) MPS.

The stated considerations on the diversity of the methods of the class of the IPU are illustrated in the diagram in fig. 1. It should, however, be emphasized that the classification of the MPS, shown in fig. 1, is not exhaustive. Here only the main classification criteria and only some of the subclasses of methods are noted. Within each of these subclasses, in turn, separate groups and subgroups of methods can be distinguished, combined according to some additional signs that differ from those discussed above. In particular, MPS can be realized both numerically and analytically, which leads to the emergence of additional MPS subclasses - numerical and analytical.

The unifying principle of all the mentioned methods are, as already noted, the initial theses of the MPS formulated above, which underlie each of these methods and allow us to consider their diversity as a single class - a class of methods of polyargument systems.

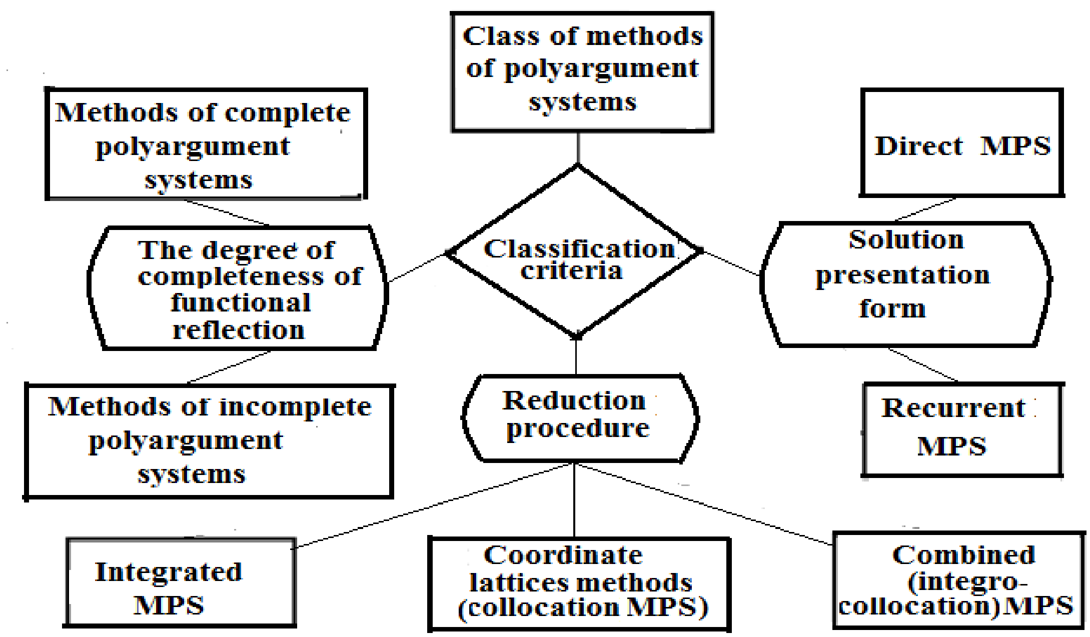


**Fig. 1. Classification of polyargument systems methods**

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