

The problems of transition from serial to parallel program in solving the mathematical physics problems on complex grids

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Difficulties in design of effective parallel programs for high performance multiprocessor computer systems make the use of these systems less effective in solving complex applied tasks. Parallelizing compilers and interactive systems of parallelizing at the level of source text haven't worked out. Target programs are less effective than expected.

Here are considered the problems of designing parallel programs to solve computer tasks by grid-based methods. Some ways out are suggested. The peculiarities of grids groups (or in other words, information dependencies between the program variables) are taken as the base for the whole approach. We use the experience in solving the tasks on static structured grids, static unstructured grids and dynamic unstructured grids by parallel systems with distributed architecture.

'Neighboring' data in structured grids are set by index displacements. They are defined by rectangular coordinate system. For unstructured grids we use irregular graph. It makes parallelising more difficult. The problem of writing the programs to provide data and computations distribution and the problem of efficiency of execution become more complicated. The efficiency of the program performance depends on minimization of the number of exchanges between the processors and the balance of the processors' loading.

The main problems of parallel program design on the structured grids and the methods of their solution are illustrated by the example of parallel programming system NORMA [1,2].

New methods of parallelizing are proposed for the programs on the unstructured grids. These methods are based on using universal parallel interface. It is a number of subroutines supporting parallelization and the rules of their including into the serial program to minimize changes in the code of the serial program. These methods define:

- 1) base data structures being “characteristic” for considered tasks’ group and the methods of their distribution among the processors;
- 2) parallel interface structures with common parameterized variables, necessary for supporting subroutines’ implementation;
- 3) subroutines’ library supporting work with base data structures on parallel system;
- 4) the rules of text modification of source serial program.

The parameters of subroutines are supposed to be only the names of the variables, if the variables are the calculated values set by the user.

The proposed methods could be generalized for the case of dynamic adaptive unstructured grids (the case of creating and deleting grid’s nodes in the process of calculation).

Given results may be interesting both for the applied specialist, in need of parallel program to solve his computer task, and for developing the systems to analyze and parallelize the programs.

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1. A.N. Andrianov, A.B. Bugerya, K.N. Efimkin. NORMA is a specialized system of parallel programming. Siberian seminar on parallel programming, Tomsk, 2002, p.33-45 (In Russian).

2. [http: //www.keldysh.ru/pages/norma](http://www.keldysh.ru/pages/norma)