

Mathematical Modeling using Supercomputers with Parallel Architecture

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Mathematical modeling using supercomputers rather gradually but persistently is included into practice of applied researches. As a rule, here it is necessary to consider the complex nonlinear multidimensional unsteady equations with complicated internal structure and rheology. Literally for last one – two years there was a powerful jump in development of the supercomputer engineering as itself (Japan, USA). So the performance of new Japanese supercomputer NEC Earth Simulator (NEC ES) comes to 35,6 trillion mathematical operations per one second. American specialists develop the supercomputers with yet more performance (hundred trillions per second). To this and other questions also the mentioned conference in India HPC-6 was devoted.

It is extremely important, in our opinion, for users of such techniques (End Users) to comprehend the priorities of problems and methods (algorithms, solvers), allowing *rationally* using so high performance tools for research. Now with us at Russian Academy of Science the project on development of effective parallel algorithms for solution of high complexity problems, is started.

The purpose of the project is to develop effective parallel algorithms to solve wide circle of the problems of high complexity, described by equation systems in partial derivatives. Basis of the development is application of some modern algorithms applicable for calculations by parallel computers, such as method of splitting, "large particles" method, method of flows, statistical methods, method of finite elements etc. The idea consists in creation of a certain technology of parallel computing as a set of original codes of the software documentary prototypes, parallel - dependent part of which will not be changed, and the applied part is created by the user modification of the closest program prototype. Realization of the project will allow to reduce sharply the terms of development of new parallel applications and to use effectively available multiprocessing computing resources.

In the report some stages of the development of such supersolver are briefly formulated.

As the application the solution of high complexity problems in such most actual directions of a science and engineering as aerodynamics and fluid dynamics (on the basis of "large particles" method the package of applied problems " Gas Dynamics Tool " is developed) are considered, problems of seismology (construction of three-dimensional seismograms is especially important) and dynamic fractures are investigated. Application of computer technologies in medicine (new and very perspective field of applications) seems to be very important.

Practically, these directions (and also the problems, connected with the developments in nanoelectronics) were noted by the majority of contributors at the conference HPC-6. We offer new Russian developments here.

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