OBTAINING EXAFLOPS PERFORMANCE FOR GLOBAL OPTIMIZATION PROBLEMS

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Great computational potential of modern supercomputer systems allow us to attempt solving many complex science and applied problems which was not able to analyze earlier. It is expected that supercomputer systems with the best performance will be substantially multiprocessors (up to billion computational cores), hybrid with various types and computational elements and multilevel structure for executing computations (distributed computational units - computational nodes with shared memory - multicore processor cores - computation accelerators). Effective utilization of huge computational potential of exaflops systems is a global "challenge"problem to all spectrum of computational sciences. Conditions for successful over-coming this problem are the following:
– significant time-consuming of solved problems (up to 10^{18} operations);
– high parallelism potential (scalability) of computation (up to use more that 10^9 processors);
– low intensity of information communications (locality) between parallel executed computations;
– computation stability to computational hardware failures which are unavoidable for so great number of computational elements.

It can be demonstrated that all given above conditions are fulfilled for global optimization problems.

In this paper the problems of multidimensional multiextremal optimization and parallel methods of their solution are considered. Only a general assumption is made regarding the optimizable function: the function is preset algorithmically (in the form of an algorithm of computation of values by input parameters) and satisfies the Lipschitz condition with an a priori unknown constant (problems of this kind are often found in applications). Within the limits of the considered approach solution of multidimensional problems is reduced to solution of one-dimensional problems equivalent to multidimensional problems. For problem dimension reduction a multi-level scheme is proposed, which combines the ideas of Peano-type space filling curves and nested optimization. The offered parallel algorithm uses a multi-level scheme of dimension reduction for effective parallelizing. Results of numerical experiments confirm convergence and speedup of the parallel algorithm in comparison with its sequential prototype.