SOME DIFFICULTIES OF NUMERICAL SOLUTION OF OPTIMIZATION PROBLEMS WITH A BILLIONS OF VARIABLES [1]

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Optimization problems with large and very large dimensions ("Huge Scale optimization problems") occur naturally in a wide range of scientific fields - images recognition, machine learning, big data analysis, optimization of atomic and molecular clusters, analysis of genomic chains, analysis of telecommunication networks and many others. Yu.E. Nesterov recently proposed (see [1]) the following classification of optimization problems by number of optimized variables: "Small" - up to 100 variables, "Medium" - from 10^3 to 10^4, "Large" - from 10^5 to 10^7 and "Huge" - more than 10^8 variables. Steady progress of modern computer technology, especially in parallel architectures, and its availability expansion to a wide user gives optimism in investigation of solving optimization problems with discussed dimensions. "Bottleneck" in this scientific topics in our opinion is algorithms and optimization computational technologies weakness. It can be argued that the statement of the problem, "social inquiry" and technical probability are ripe, the next "move" should do mathematics and mathematicians.

Vigorous research of discussed problem conducted in a number of scientific organizations, both in Russia and abroad. In Belgium, serious progress on huge problems achieved by a team of Yu.E. Nesterov, in U.S. successfully working group of A.I. Nemirovsky and several others, in UK – P. Richtarik group, in Russia - group of A.V. Gasnikov in MIPT (PreMoLab). The number of scientific publications on this topic is growing rapidly.

The report discusses the proposed algorithms for solving test and applied multidimensional optimization problems. The possibility of modifying the method proposed for about half a century ago by B.T. Polyak in [2] is investigated. With using algorithms based on this approach, it was possible to solve a number of separable convex optimization problems with dimension up to 10^{11}. With the use of previously implemented techniques (see, eg. [3]) authors developed specialized computational technologies for Keating potential optimization problems with number of variables more than 10^7. Also was solved a number of Morse potential optimization for atomic-molecular clusters with world-record sizes. The results of numerical experiments were obtained using both personal computers and high-performance computing systems.

REFERENCES

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