

IMPROVING OPTIMIZATION PERFORMANCE WITH PARALLEL COMPUTING

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Scientific and technological progress in many areas of human activity leads, on the one hand, to the expansion of the use of computing technology, and on the other hand, computing technology is used to solve more complete models when studying complex models and objects of modern technology. One way to improve productivity is to parallelize computations [1].

Parallelization transformation is usually performed in two stages. At the first stage, the parallelism of an algorithm or problem is "revealed" and recorded in some machine-independent form, and at as a program model, a directed graph G is considered, the set of vertices of which $V = \{v_1, v_2, \dots, v_n\}$, $|V| = n$, corresponds either to individual operators of the original program or to elementary operators into which the operators of the original program are divided during syntactic analysis.

The set of directed arcs $u = \{u_1, u_2, \dots, u_m\}$, $|u| = m$, corresponds to possible transitions between these operators. We will assume that the program graph G is an arbitrary cyclic graph with one input vertex v_1 and one output vertex - v_n , and at least one path from the input vertex to the output vertex passes through any vertex of this graph. In studies devoted to the optimization of calculations, an important place is occupied by works aimed at reducing the calculation time of repeating sections of programs, in particular, cycles.

This is due to the fact that the main time of solving many problems falls on repeating sections. One of the ways to optimize the calculation of cycles is based on the identification and use of patterns of information-logical connections between iterations. When analyzing parallelism, the information-logical mode of the section is "revealed". As a rule, when analyzing cyclic sections, "nests" are considered, that is, sequences of cycles nested one into another, and the concept of "iteration space" is introduced. Each iteration is characterized by the value of the vector (i_1, \dots, i_n) , where i_k is the iteration execution number at the k -th nesting level. "Portions" of iterations that can be executed simultaneously are parallel planes of the iteration space.

References (translated):

1. Robert B. Schnabel. Parallel Computing in Optimization // Computational Mathematical Programming. – 2023. – p. 357 – 381
2. Huiskes M. Automatic Differentiation and Uncertainty Analysis // IIASA Interim Report. – 1998. – 43 p.