Network Programming Method in Nonlinear Optimization Problem

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Nonlinear optimization problems (those of discrete optimization, in particular) are NP-difficult problems for which exact solution methods do not exist. Most effective methods to obtain quasi-optimal solutions are the branch and bound method and the dynamic programming method. Unfortunately, the latter can be applied only to a limited class of problems, while the branch and bound method's efficiency depends on the precision of lower or upper bounds. An effective way to estimate the bounds values is to implement Lagrange multiplier method. However, since the 60-th years these methods did not undergo essential changes.

In 2004 authors (Burkov and Burkova 2005) proposed a new approach to discrete optimization problems. The main idea boils down to presenting the function as a superposition of less complicated functions. Such a superposition may be realized in the form of a network, where the starting input nodes are variables, intermediate nodes are the functions of superposition with the final node determining the value of the function. The method has been called the network programming method (particularly the dihotomic programming method). This method can be applied in cases when the goal function and the constraints have similar network structures. In this case less complicate optimization problems are solved in each intermediate node. The problem's solution at the final node provides the upper or lower bounds for the problem. If the structure of the network is a tree, the problem's solution at the final node is an exact one. If the structure is a branch of a tree we receive the dynamical programming Bellman's method.

In the paper under consideration the network programming method is applied to nonlinear optimization problems. The generalized duality problem's (GDP) definition is introduced. In particular cases of GDP boiling down to the Lagrange multiplier method. It is proved that GDP represents a concave programming problem.

Both necessary and sufficient conditions of the optimality GDP integer linear programming are received.

Reference

Burkov, V.N. and Burkova, I.V. (2005), Network Programming Method, Problems of Control, 3, pp. 25-27 (in Russian).