CMST AND TELEPAK PROBLEMS. DECOMPOSITION APPROACH

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1. Single Link Capacity: The Capacitated Minimum Spanning Tree (CMST) Problem.

Let I = {1, 2, … , n} be the index set of the non-root nodes to be connected to the root node (indexed by 0). With each $i \in I$, we associate its traffic demand p_i expressed, for instance, in bits per second (bps). If we assume that a single type of link with capacity Q is used to build the network, then the cost w_{ij} of connecting any two nodes i and j (i, j$\in$ $\{i_0\}\cup$ I) is known. The minimum cost network which satisfies the traffic demand and observes the link capacity constraint is sought. This problem is the CMST problem with respect to cost w_{ij} and capacity Q. CMST has been shown to be NP-hard by Papadimitriou [1].

2. Multiple Link Capacities: Telepak Problem.

CMST model assumes that link capacity and hence link cost are independent of the amount of traffic they carry. The utilization of a link, which is far from the root, is very low. Given a variety of link capacities actually being provided by industry, network costs can be reduced significantly if link capacities are assigned according to the traffic they carry. Allowing different link capacities in a tree network gives rise to the Telepak problem.

To solve the problems 1 and 2 a decomposition model is proposed based on the approach (Krasnoshchekov, Morozov and Fedorov [2]) The basic idea of the decomposition approach is as follows: instead of the initial, complex optimization criterion in the problem, several particular simpler criteria are introduced.

If the partial criteria are monotonically coordinated with the global one (i.e., the fact that an alternative is superior with respect to the partial criteria implies its superiority with respect to the global one), then the solution of the initial problem is contained in the Pareto set of the coordinated multi-criteria problem.

An application of the decomposition approach is most advisable when the global problem and the problems with partial criteria have different classes of complexity (Peltsverger, Khavronin [3]) This model allows us to reduce the solution of the initial NP-hard problems to a solution of the sequence of partial problems of polynomial complexity. In this paper, we propose an application of the model (Peltsverger, Khavronin [4]) for solving problems 1 and 2.

References

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