A Bi-level Steiner's Tree Problem: An Application in Telecommunications Networks

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Abstract

In this lecture a hierarchized Steiner's tree problem in networks is proposed. Users need to be connected to capacitated hubs and then the selected hubs will be connected among them and some extra hubs if necessary considering the latency of the resulted network. Connection between hubs can be seen as obtaining a Steiner's tree. The problem is modelled as a bi-level mathematical programming problem where two decision levels are considered. In the upper level, the allocation of users to hubs is made aiming the minimization of the total network's connection cost. On the other hand, the lower level consists in minimizing the user's latency with respect to the information flowing trough the capacitated hubs. Before solving the bi-level model, some concepts regarding the bi-level semifeasible solutions are introduced based on [1]. Then, a co-evolutionary algorithm is developed. The proposed algorithm exploits the particular bi-level structure of the problem (similar as in [2]) by the use of parallel computing in one of the two populations. A specific application for the model here proposed is made for the topological design of a Local Area Network studied in [3]. Computational experimentation is conducted considering a battery of created instances. Numerical results show the importance of the proposed approach when the lower level problem cannot be optimally solved in an efficient manner. Finally, a discussion about the effects that results from having a complex problem in the lower level is presented.

References

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