

Column generation technique for optimization problem in survivable elastic optical networks

Nowadays, the telecommunication networks are indispensable part of the society every day life. Year by year, we observe that they are increasingly popular. However, at the same time they face challenges of still increasing network users requirements. This is a reason of their continuous and very intensive development, which entails new, challenging optimization problems and necessity to implementing efficient algorithms to solve them.

The one of the considered project objectives is to focus on the optimization problem, which was found as a very important by the project authors. The problem is a consequence of an extensive network technologies development and changing requirements of network users. The problem covers task of joint optimization of three types of network flows (unicast, anycast, and multicast) in elastic optical networks with dedicated path protection. To the best of authors knowledge, this problem has not been studied in the literature so far.

The main project objective is to propose and evaluate a column generation-based algorithm, dedicated to solve this problem.

The column generation technique is an example of decomposition method, which allows to obtain sub-optimal results for complex optimization problems. The method efficiency was proved in numerous papers, including papers related to optimization of telecommunication networks. Against this background, the project authors hypothesize that column generation technique can be used in an implementation of efficient algorithm to solve considered optimization problem and can outperform other methods dedicated to solve the same problem.

The project aims also at verifying the hypothesis by means of design and implementation of a column generation-based algorithm dedicated to solve considered optimization problem and its efficiency evaluation based on the comparison with exact method and other reference algorithms proposed in the literature so far and adapted to the same problem formulation.

In order to realize project objectives, the authors plan to prepare a dedicated simulator, which will implement, among others, the considered column generation-based algorithm. Then, the authors plan to use the simulator to perform numerical experiments focused on three aspects: (i) efficiency of the proposed column generation-based algorithm as a function of additional improvement mechanisms proposed by the authors, (ii) evaluation of efficiency of the proposed column generation-based algorithm based on the comparison with results of the reference methods (proposed in literature and adapted to the considered problem formulation), (iii) efficiency of the proposed column generation-based algorithm as a function of testing scenario characteristics (e.g., number of network nodes, total traffic volume, number of candidate paths, etc.).

The project results will include new mathematical models, algorithms, and numerical experiments results presented as a set of interesting dependencies and conclusions.

Consequently, the project results will be undoubtedly relevant development of the knowledge from modeling of computer networks, integer linear programming (ILP) modeling, development and applicability of the column generation technique, algorithmic, and optimization. Thus, the results will be new knowledge from telecommunication, computer science, and mathematic. This knowledge can be interesting and essential for many scientists all over the world, therefore the project authors aim at sharing this knowledge and publishing it in reputable international magazines and during international conferences. What is more, the project results can be relevant and inspirational in designing and implementing new telecommunication networks standards and protocols.

Considering **the project topic relevance and novelty** as well as potential **significance of the expected results**, the project authors plan to focus on the proposed project task.