Design of Survivable Networks with Bounded-Length Paths

D. Huygens[1], M. Labbé[1], A. R. Mahjoub[2], and P. Pesneau[3]

Abstract: We consider the Two-edge connected Hop-constrained Network Design Problem (or THNDP for short), which consists, given a weighted graph $G = (N, E)$, an integer $L \geq 2$, and a subset of pairs of nodes D, in finding the minimum cost subgraph in G containing at least two edge-disjoint paths of at most L hops between all the pairs in D. First, we show that the THNDP is strongly NP-hard even when the demands in D are rooted in some node s and the costs are unitary. However, if the graph is complete, we prove that the problem in this case can be solved in polynomial time. We give an integer programming formulation of the problem in the space of the design variables when $L = 2, 3$. Then, we study the associated polytope. In particular, we consider the case where all the pairs of nodes of D are rooted in a node s. We give several classes of valid inequalities and discuss separation routines. Using this we develop a Branch-and-Cut algorithm, and present some computational results for $L = 2, 3$.

[1] Département d'Informatique
Université Libre de Bruxelles
Boulevard du Triomphe, CP 210/01, 1050 Bruxelles, Belgium
dhuygens@ulb.ac.be, mlabbe@ulb.ac.be

[2] LIMOS, Université Blaise Pascal, Clermont II
Complexe Scientifique des Cézeaux, 63177 Aubière Cedex, France
Ridha.Mahjoub@math.univ-bpclermont.fr

[3] MAB, Université de Bordeaux 1
351, Cours de la Liberation, 33405 Talence Cedex, France
pierre.pesneau@math.u-bordeaux1.fr