(1,2)-Survivable Networks : Facets and Branch-and-Cut

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Abstract

Given a graph $G = (V, E)$ with edge weights and an integer vector $r \in \mathbb{Z}_+^V$ associated with the nodes of V, the survivable network design problem is to find a minimum weight subgraph of G such that between every pair of nodes s, t of V, there are at least $\min\{r(s), r(t)\}$ edge-disjoint paths. In this paper we consider that problem when $r \in \{1, 2\}^V$. This case is of particular interest to the telecommunication industry. We first consider the case when $r(v) = 2$ for all $v \in V$. We describe sufficient conditions for the so-called F-partition inequalities to define facets for the associated polytope. As a consequence, we show that the critical extreme points of the linear relaxation of that polytope may be separated in polynomial time using F-partition facets.
Next we consider the case where $r \in \{1, 2\}^V$. We first describe valid inequalities that generalize the F-partition inequalities. We discuss separation algorithms for these inequalities as well as for the so-called partition inequalities. Finally, we introduce a Branch-and-Cut algorithm based on these results and present some computational results. These show that the F-partition inequalities are very effective for the 2-connected subgraph problems.