Connected Dominating Sets: Formulations, Algorithms and Extensions

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Given an undirected graph $G = (V, E)$, a subset W of V is a dominating set of G if, for every vertex $i \in V \setminus W$, there exists an edge $e = [i, j] \in E$ with $j \in W$. The dominating set is connected if the subgraph it induces in G is connected. Accordingly, the Minimum Connected Dominating Set Problem (MCDSP) is to find a connected dominating set with as few vertices as possible. MCDSP and its closely related Maximum Leaf Spanning Tree Problem have been suggested in the literature as a model to, among others, ad-hoc wireless networks and fiber optics networks where regenerators of information must be used. In our presentation we will address our ongoing research on $\{1, 2\}$-connected dominating sets and also on some related topics. Among these we will discuss the Simple Cycle Problem, where one might be interested in finding, for instance, a shortest or a longest simple cycle of G. Additionally, we will also discuss the Ring-Star Problem, that has applications in the design of telecommunication networks.

For all problems above we present new formulations, valid inequalities to strengthen them and branch-and-cut algorithms. Computational results will be presented, indicating that our solution algorithms are competitive with those found in the literature.

This is a joint work with Alexandre Salles da Cunha and Luidi Simonetti.