Semitotal Domination: New hardness results and a polynomial-time algorithm for graphs of bounded mim-width

Esther Galby, Bernard Ries, University of Fribourg
Andrea Munaro*, West Virginia University

A semitotal dominating set of a graph G with no isolated vertex is a dominating set D of G such that every vertex in D is within distance two of another vertex in D. The minimum size $\gamma_{t2}(G)$ of a semitotal dominating set of G is squeezed between the domination number $\gamma(G)$ and the total domination number $\gamma_t(G)$.
Semitotal Dominating Set is the problem of finding, given a graph G, a semitotal dominating set of G of size $\gamma_{t2}(G)$. We continue the systematic study on the computational complexity of this problem when restricted to special graph classes. In particular, we show that it is solvable in polynomial time for the class of graphs with bounded maximum induced matching width by a reduction to Total Dominating Set and we provide several approximation lower bounds for subclasses of subcubic graphs. Moreover, we obtain complexity dichotomies in monogenic classes for the decision versions of Semitotal Dominating Set and Total Dominating Set.
Finally, we show that it is NP-complete to recognise the graphs such that $\gamma_{t2}(G) = \gamma_t(G)$ and those such that $\gamma(G) = \gamma_{t2}(G)$, even if restricted to be planar and with maximum degree at most 4, and we provide forbidden induced subgraph characterisations for the graphs heriditarily satisfying either of these two equalities.

Keywords: Semitotal Dominating Set, Total Dominating Set, Computational complexity, Bounded mim-width