

In the weighted Minimum 2-Edge Connected Steiner Subgraph (2-ECSS) problem, the input is a simple undirected edge-weighted graph. The task is to find a subgraph with the least cost (sum of weights of edges), such that for each pair of vertices u, v from a distinguished subset (called *terminals*), there exist at least two edge-disjoint u - v paths in the subgraph. We give a randomized XP algorithm, parameterized by the number of terminals, for weighted Minimum 2-ECSS in case of uniform edge weights, at the heart of which lies the randomized algorithm by Björklund, Husfeldt, and Taslaman (SODA 2012), for finding a shortest cycle through a given subset of vertices.

A close variant of weighted Minimum 2-ECSS is the weighted Minimum 2-Edge Connected Steiner Multi-subgraph (2-ECSM) problem. In weighted Minimum 2-ECSM, the solution subgraph can use multiple copies of each edge in the input graph, paying separately for each copy. We show that weighted Minimum 2-ECSM is polynomially equivalent to a problem called Bi-directed Strongly Connected Steiner Subgraph (BI-SCSS), for which an FPT algorithm is known due to Chitnis et al. (TALG 2021). We show that by combining the results of Jordán (Discret. Appl. Math. 2001) and Feldmann et al. (SOSA 2022), one can obtain an FPT algorithm for weighted Minimum 2-ECSM (parameterized by the number of terminals), which, as we prove, gives a faster FPT algorithm for BI-SCSS, compared to the one by Chitnis et al.