A Two-level Meta-heuristic Approach for the Minimum Dominating Tree Problem

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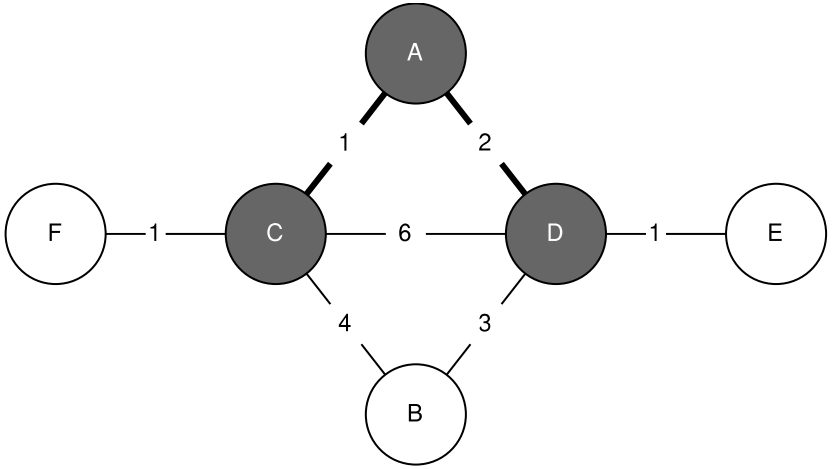
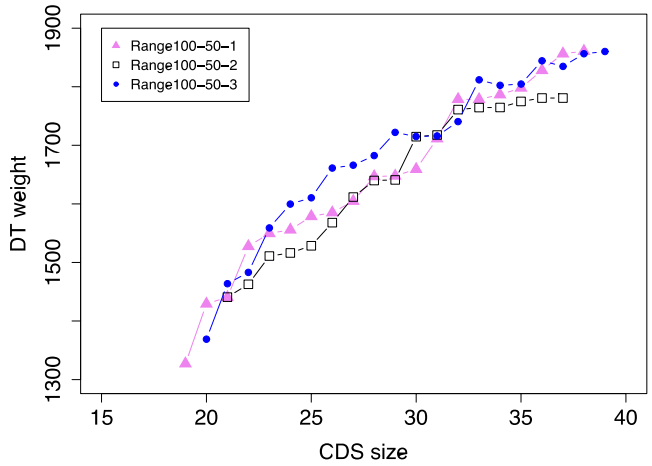
Problems & Ideas

- Minimum Dominating Tree Problem:
  - The MDT problem looks for a sub graph of $G = (V, E)$ denoted as $T = (V', E')$ with the minimum total weight, such that any vertex not in V' is adjacent to at least on vertex of V' with the condition that T is connected without any cycle.
- Ideas: The proposed method consist of a solution sampling phase and two local search-based procedures nested in a hierarchical structure with fine designed evaluation methods.



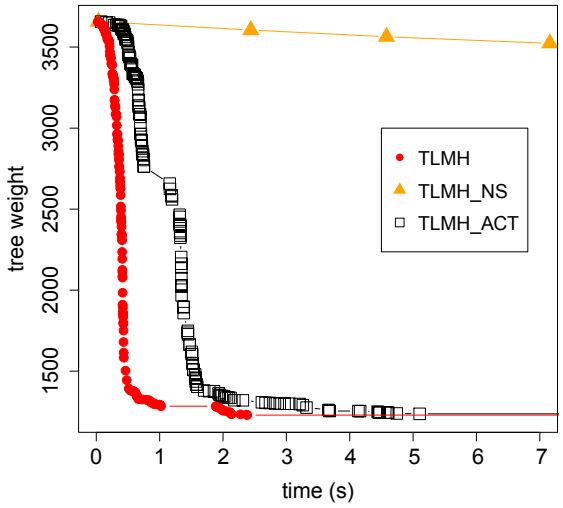
The MDT $(\{A, C, D\}, \{(A, C), (A, D)\})$ forms a robust backbone to the whole network which can be well adapted to broadcast protocols.

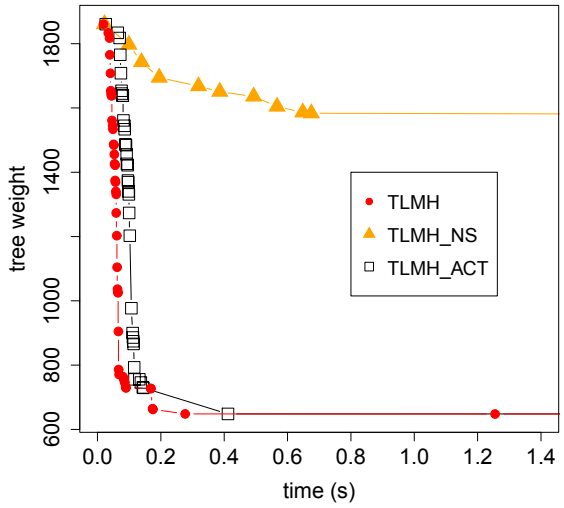


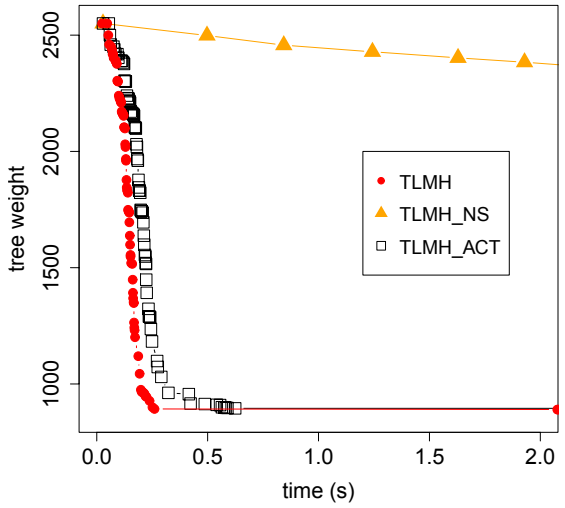
We observed that the dominating tree weight tends to be smaller if deduced from a smaller CDS. Based on this phenomenon, we implement a sampling phase to improve the convergence speed of the proposed algorithm

Main Contributions

- Contributions:
  - A hierarchical meta-heuristic framework consisting of two nested local search procedures to tackle the MDT problem.
  - An effective neighborhood structure for the inner layer local search and a fast neighborhood evaluation method that enable TLMH to achieve a better balance between exploitation and exploration.
  - A sampling phase that quickly determines the promising search space providing a better convergence for TLMH.







Comparison results show that the full-featured algorithm converges much faster than the others. The algorithm without the sampling phase (NS) is way worse than the other two. The algorithm without the fast evaluation method (ACT) converges slower than the full-featured one.