

Efficiency Analysis of Vertex Clustering in Solving the Travelling Salesman Problem

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Abstract

The Traveling Salesman Problem (TSP) is a problem to find the shortest path in a graph visiting every nodes exactly once and returning to the start node. In the case of multi-salesman travelling (MTSP) problem more than one cycles should be generated (each salesman has a separate cycle) and each node is visited only by one salesman. Due to the high complexity of TSP, there exists no algorithm for global exact optimization with polynomial cost. For example, the Held-Karp algorithm solves the problem in $O(n^2 \cdot 2^n)$ complexity. In order to provide an acceptable solution for real life problems, the TSP are usually solved with some heuristic optimization problem.

In our investigation, we have focused on the most widely used method, the application of Genetic Algorithm to find a good route in the graph. The paper proposes a multi layered optimization model, where the node set is partitioned into clusters or into hierarchy of clusters. To reduce the problem size, it seems reasonable to group the near nodes into clusters and to perform a hierarchical optimization. There is a within-cluster optimization to determine the optimal route within the cluster and there is an intra-cluster optimization to determine the optimal path among the clusters. This approach implements the widely used divide and conquer concept, the problem of big complexity will be split into several subproblems of lower complexity.

Based on the test experiments the proposed method is superior to the single level optimization method for both the TSP and MTSP problems (Table 1).

Number of nodes	TSP no clustering	TSP 2-level clustering	TSP 3-level clustering	MTSP no clustering	MTSP 2-level clustering
50	763	523	550	1328	1043
400	10938	1647	1791	16820	4177
1000	36156	5801	3528	41052	6097

Table 1: The length of the local optimum route

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