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A hybrid optimisation method for vehicle routing in a fleet of multi-compartment vehicles with controlled temperature settings

This work addresses the Multi-Compartment Vehicle Routing Problem (MCVRP), relevant for transporting goods that must remain separated or require distinct temperature conditions. We consider a predefined fleet consisting of three vehicle types: room temperature, refrigerated, and dual-compartment (room temperature and refrigerated). The distribution scenario involves multiple pick-up points and a single logistics center. The primary objective is to minimize total operational costs, which include fixed vehicle expenses, maintenance, and time-related costs associated with transportation and loading activities. Another factor to consider is the increased energy consumption of refrigerated compartments, which require more fuel or electricity to cool, impacting the cost structure even more. To address this, we propose a three-step hybrid solution approach. First, demand points are grouped in an optimal number of clusters. Then, we perform route optimization within each cluster, taking into account vehicle capacity and demand compatibility. In the final step, each cluster is treated as a single node, and inter-cluster routing is optimized. Linear programming is applied in the latter two steps. This method combines the strengths of exact and heuristic techniques, delivering high-quality solutions while ensuring cost-effective fleet utilization.

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