A Multi-Resource Routing Problem: Container Delivery in Urban Area

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Abstract

A real-world container drayage problem, were containers are transported between an intermodal terminal, a container terminal and customer locations is considered. We model the problem as a Multi-Resource Routing Problem (MRRP) including trucks, drivers, trailers and containers. Given a fleet of trucks and drivers, and a fleet of trailers, the goal is to utilize these resources most efficiently to complete a number of given orders. Orders consist of several tasks with time windows, such as picking up a container at the terminal, delivering it to a customer, and bringing the processed container back.

A novel aspect of this problem, usually neglected in the literature, is the management of trailers, which are required to transport the containers. Here, the compatibility between container types and trailer types must be considered. Thus, the decision which trailer should be attached to which truck depends on the containers which must be transported on the day, the availability of trailers, and the toll costs of the truck and trail combination on the highways.

To model the problem formally, we present a Mixed Integer Program using a multi-commodity flow formulation on a constructed graph. Resources and tasks are represented by nodes and the daily plan of each truck is a path. We also propose a metaheuristic approach based on variable neighborhood search which also utilizes the same graph in order to reduce the search space. Classic neighborhood structures, as well as, problem specific ones are used in combination and contribute to the overall success.

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