

A Capacitated Multi-Level Arc Routing problem with Intermediate Facilities in Waste Collection

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In densely populated cities, waste collection systems can be complex, with multi-level intermediate facilities or different types of vehicles working together. Therefore, it is not appropriate to describe the problem only by the classical arc routing model or vehicle routing model. This project is inspired from such a situation in Shaanxi Province, China, where the collection problem is best described as a capacitated multi-level arc routing problem with intermediate facilities.

There are two types of fleets in this problem. The first type is manual vehicle (MV), which are mainly responsible for servicing arcs with slight and dense demands, such as the rubbish bin nearby streets, and they unload at first level intermediate facilities, named waste collection hut. The second type is compactor vehicles with compression (CV). Arcs served by CV generally have larger demands, such as big rubbish cans and sacks. In addition, the waste placed in the waste collection huts must be served by the CV. The CVs unload at transfer stations. Generally, to avoid long wait time and congestion in the areas where the transfer stations are located, manual operation vehicle uploading at transfer station is forbidden.

A mixed integer programming model is presented and GUROBI is used to solve small instances of the problem. Furthermore, we present an adaptive large neighborhood search (ALNS) algorithm which simultaneously adjust both types of vehicles and their coordination in the waste collection huts. The classical CARP benchmarks are adapted to the problem, and experiments are carried out for small, medium, and large-scale instances.