CVRP with sequence based pallet loading and axle weight restrictions with and without dense packing

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Abstract

This paper presents an Iterated Local Search (ILS) for the CVRP with sequence based pallet loading and axle weight restrictions with and without dense packing. The problem deals with the distribution of pallets to different locations while taking into account that items may not be shifted during the trip and that axle weight limits need to be respected. The structure of the metaheuristic as well as preliminary results will be discussed.

Keywords: CVRP, packing problem, sequence-based loading, axle weight restrictions

An Iterated Local Search (ILS) for the CVRP with sequence-based pallet loading and axle weight restrictions with and without dense packing is presented. The problem has its application in the distribution of pallets to various locations and considers sequence-based loading and axle weight limits. Sequence-based loading ensures that no consignment is placed in such a way that it blocks the removal of items to be delivered earlier on the route. This constraint is commonly used in VRPs. Axle weight limits impose a great challenge for transporters since they risk high fines when violating these limits, and axle weight restrictions are mostly not incorporated into their current planning programs. Moreover, violations are a threat to traffic safety and may cause damage to the road surface. The centre of gravity of the pallets is used to calculate the weight on each of the axles, which makes it necessary to know the position of each pallet inside the truck. To the authors' knowledge, Pollaris et al. (2014a) are the first to address the CVRP with sequence-based pallet loading and axle weight restrictions. They present a

mixed integer linear programming model to solve the problem exactly. For an overview of literature concerning loading constraints integrated in vehicle routing problems, the reader is referred to Pollaris et al. (2014b).

We consider two variants of the above described problem. In the first problem type, pallets are packed dense. Dense packing means that there may not be a gap between two consecutive pallets inside the vehicle. This makes it easier for the driver to secure the cargo than when pallets are spread over the vehicle. In the second problem type, gaps may be left in the loading area between pallets of consecutive customers. A single customer sequence therefore may result in different possible packing schemes. The feasibility check in terms of axle weight limits needs to consider all packing schemes. Since the number of pallets in a single vehicle is limited, this problem can be solved exactly with Cplex in a limited amount of time. The solution method employed for the problem without dense packing is a matheuristic. The routing part is solved heuristically with the ILS while the feasibility check for the axle weight limits is computed exactly.

The structure of the metaheuristic (for the problem with dense packing) and matheuristic (for the problem without dense pacing) will be described as well as preliminary results of their performance.

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References

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