Vehicle Routing with Multi-Dimensional Loading Constraints

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One of the most widely researched problem of operation research is the vehicle routing problem (VRP), which also has numerous real life applications and many mathematical variations. There are also many exact solving and heuristic algorithms available in the literature for each of these variations. The majority of these models do not consider the loading of the vehicle, and those few that do consider, have mostly only a one-dimensional loading constraint, like weight, volume or fragility constraints and these models do not care with the real geometric loading of the items along the given route. According to our knowledge, the usage of models in practice, that take the geometric loading and other constraints into account at the same time, is very limited, mostly because of its high combinatorial complexity.

In this talk we present a vehicle routing model, which is a combined optimization of the geometric loading freight into vehicles, while not exceeding the weight constraint and the routing of the vehicles along a road network, with the aim of serving customers with minimum travelling cost. We investigate, how such loading and routing is possible for a given set of 3-dimensional items and a given set of vehicles.

Since this problem is a generalization of two well-known, NP-hard problems, the capacitated vehicle routing problem (CVRP) and the three-dimensional bin packing problem (3DBPP), this problem is also NP-hard. Because of this reason, we can not expect to provide a fast (polinomial) algorithm, that could solve this problem to optimality in a reasonable time for larger, real-world problem intstances. Therefore, we provide a heuristic solution, that does not provide an optimal solution, but an acceptable one in a reasonable time. We'll also provide measurements for our solution with empirical analysis.