
A Template-based ALNS for the Consistent E-VRP with Backhauls and Charging Management

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Abstract

We consider the delivery and collection of parcels to business customers over a predefined time horizon. In order to enable the sustainable delivery and collection of parcels, electric vehicles are used. A backhauling policy is followed, i.e., all delivery operations in a vehicle route are performed before collection of parcels is started. Each tour has a maximum length given on the one hand by the allowed working time of drivers and on the other hand by the battery range of the electric vehicles. Between the delivery tour and the collection tour vehicles return to the depot, where recharging is possible. Since fast charging slots are a limited resource, delivery and collection tours have to be optimized in combination with the scheduling of the recharging operations. In addition, business customers rely on regular delivery times and familiar delivery personnel. Therefore, consistency when visiting customers for delivery and collection is also to be maintained, implying that the same person should visit the same customer at approximately the same time every day. We aim at identifying a set of consistent delivery and collection tours for electric vehicles, considering the limited autonomy of vehicles and the recharging planning, and optimizing a combination of criteria: vehicle fixed cost, operating time of each vehicle (including waiting time for recharging and recharging time), time consistency, driver consistency. We propose a metaheuristic approach based on efficient and effective operators for the recharging management while respecting consistency requirements. These operators are embedded in a Template-based Adaptive Large Neighborhood Search.

Keywords: electric VRP, consistency, delivery and collection, charging management

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