The Location Routing Problem with Intraroute Facilities

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Abstract

The transportation sector faces major challenges in developing green, flexible and efficient logistic concepts. While electric vehicles play a key role in various future logistic concepts to cope with environmental impacts, freight replenishing or unloading goods on routes is addressed for same day deliveries or waste disposal. Within these concepts intermediate stops at intraroute facilities (e.g. charging stations or freight replenishment facilities) are needed to keep vehicles operational on their routes. While intermediate stops have already been addressed from a vehicle routing perspective for different application cases (e.g. electric fleets, waste disposal, grocery distribution, city logistics), location routing approaches addressing integrated routing and siting decisions for intraroute facilities are still sparse. Besides a first location routing approach focusing on simultaneous routing and siting decisions for electric logistic fleets, no research has been done in this field yet. Thus, a generic modeling approach addressing the whole range of application cases is still missing. Against this background, we present the Location Routing Problem with Intraroute Facilities, a generic model for simultaneous vehicle routing and intraroute facility siting decisions. In addition, we present an Adaptive Large Neighbourhood Search to solve large instances for the proposed application cases. Within this context we derive new penalty functions allowing for time efficient concatenation operators considering time dependent replenishing on routes. Results are shown focusing on simultaneous siting and routing decisions for electric logistic fleets. To highlight the benefit of the LRPIF, results are compared to the results of vehicle routing approaches.

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