Metaheuristic approaches for the multi-period vehicle routing problem with synchronization constraints and refuelling

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Abstract

In the context of home health care services, patients might need to be visited multiple times by different healthcare specialists or the services given by a health care specialist must be performed in a certain order over a set of days. In other words, each home health care patient has unique needs and combinations of multiple services are used to meet those needs at her/his preferred location. In order to tackle this specific routing and scheduling problem, we study the multi-period VRP with synchronization constraints. This problem is a variant of the VRP and consists of finding a set of vehicle routes to serve a set of patients who may require several synchronized visits over a set of days. Moreover, each patient must be served within a pre-specified time window in a multi-period planning horizon. Furthermore, due to the limited fuel tank capacity, a vehicle also requires refuelling at fuel station in order to visit the rest of patients along its route of the day. In this research, we name this variant of the VRP as the MP-VRPSynch with Refuelling (MP-VRPSynch-RV).
We present an integer linear-programming formulation for the MP-VRPSynch-RV and propose three population-based Hybrid Artificial Bee Colony metaheuristic algorithms. These variants include Demon algorithm, Old Bachelor Acceptance rule, and Record-to-Record Travel mechanism. To evaluate our proposed metaheuristics, we generated new test instances and used a set of single-period VRPSynch instances from the literature. The results show that our proposed algorithms produce high-quality solutions and outperform the current state-of-the-art-algorithm.

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