A hyper-heuristic approach to the home care scheduling problem

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1 Abstract

The Home Care Scheduling Problem (HCSP) involves assigning nurses to certain people or patients who are in need of support within quite strict time windows at their homes. The assignment is based on particular support requirements and qualifications of the nurses. Each nurse should visit all the assigned patients within the determined time windows to perform the tasks concerning them. During these visits, total traveling time should be minimized and a number of constraints concerning the nurses' rosters should be handled.

HCSP is a combination of two NP-hard problems, namely the Nurse Rostering Problem (NRP) and the Vehicle Routing Problem (VRP). In the literature, we can find plenty of studies related to both problems. However, very limited studies are available about the combined HCSP. A related combined problem that shows similar characteristics under simpler constraints is the Vehicle Routing and Scheduling Problem with Time Window Constraints (VRSPTW) [9]. It is the VRP with time windows that cover the time horizon for delivering goods or services to customers. In the HCSP, different nurses with different skills are required, the services delivered are more complicated and more types of tasks are present than in the VRSPTW.

There is a limited number of papers about the HCSP in the literature [1, 2, 3, 4, 6, 7, 8]. Fast heuristic approaches are an alternative to solve the HCSP. However, the problem dependency of such optimisation strategies is an important issue to be tackled. It is possible to design an algorithm that can find high performance solutions for a specific problem or just an instance of a problem. However, the algorithm may not be successful to solve related problems or different instances or it may require lots of changes or tuning to be adapted to the new problem. Hyper-heuristics are generic search strategies that perform search over a heuristic search space instead of the solution space to clear up this case [5]. In this study, we apply a new improvement hyper-heuristic which chooses the best possible low-level heuristic at each optimization step for the HCSP to show the potential of hyper-heuristics for difficult combined problems.

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