

Adaptive Large Neighborhood Search Algorithm for Home Healthcare Routing and Scheduling Problem with Mixed Fleet

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Abstract

The objective of this study is to investigate and optimize the routing and scheduling challenges inherent in home healthcare services by focusing on a hybrid logistics framework that utilizes a mixed fleet of electric and conventional vehicles (HHC-RSP-MF). Unlike traditional Vehicle Routing Problems (VRP), this problem environment is characterized by stringent nurse competence constraints, which dictate that medical personnel can only be assigned to patients whose specific care requirements match their professional expertise. This necessity introduces a critical layer of complexity, as the model must simultaneously manage the strategic allocation of nurses to appropriate vehicles while considering the unique operational limitations of a mixed fleet, such as the varying range and charging requirements of electric units. To address these challenges, a comprehensive mathematical model was formulated, and a Adaptive Large Neighborhood Search (ALNS) metaheuristic, featuring specially designed operators and algorithmic enhancements, was developed to generate solutions for large-scale instances. The robustness and efficiency of the proposed methodology were rigorously evaluated using benchmark problems derived from literature, and the computational results demonstrate that the approach consistently delivers encouraging results across both small-scale and large-scale scenarios.

Keywords

Home healthcare, adaptive large neighborhood search, OR in healthcare

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Biographies

Gulcin Dinc Yalcin is an Associate Professor of Industrial Engineering at Eskisehir Technical University, Turkey. She obtained her doctorate degree at Anadolu University, Turkey, and subsequently held the position of post-doctoral researcher at the Department of Industrial and System Engineering at Lehigh University, Bethlehem, Pennsylvania, USA. Her research interests lie in the fields of optimization theory with a focus on their applications in various areas, including machine learning, logistics problems particularly in the context of vehicle routing, and location problems.

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