

Title	選好認識型多目的時間枠および需要優先度を考慮した車両経路問題のための新しいハイブリッドフレームワーク
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Abstract

This dissertation addresses a key gap in real-world logistics optimization by proposing the Multi-Objective Vehicle Routing Problem with Time Windows and Demand Priority (MO-VRPTWDP). Unlike traditional VRP models that focus solely on cost minimization, this new formulation incorporates customer satisfaction via a weighted waiting time mechanism, enabling more equitable and service-oriented routing, especially in domains such as healthcare logistics and premium delivery.

To address this problem across different scales and decision-making contexts, the research can be divided into 3 parts. First, a Mixed Integer Linear Programming (MILP) model is developed to validate the formulation and analyze small-scale solution behavior. It captures trade-offs between operational cost and service levels based on customer priority.

Second, a novel Multi-Thread Simulated Annealing (MTSA) algorithm is proposed to enhance scalability and exploration. MTSA introduces parallel threads and cooperation among them, significantly improving the diversity and quality of Pareto frontier approximations. Experiments show that MTSA outperforms the benchmark algorithm (MOSA).

Third, a reinforcement learning-based extension, RL-MTSA, is introduced to enable preference-aware optimization. By embedding a learning agent into the MTSA algorithm, RL-MTSA dynamically steers the search toward user-specified regions of interest. It achieves faster convergence and higher alignment with decision-maker preferences than uniform-search methods.

Overall, this research contributes a new VRPTW variant with soft-priority modeling, scalable optimization techniques, and adaptive, user-preference search strategies. The proposed methods offer practical decision support tools for the preference-aware optimization in the multi-objective vehicle routing problem.

Keywords: Vehicle Routing Problem, Multi-Objective Optimization, Simulated Annealing, Reinforcement Learning, Preference-aware Optimization