Universität Hamburg
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Ausschreibung: Abschlussarbeit am
Institut für Operations Management

Thema

Optimizing Conflict-Free Path Planning with Blocking Constraints for Autonomous Mobile Robots in Collaborative Order Picking Tasks

Kurzbeschreibung

Autonomous Mobile Robots (AMRs) are increasingly utilized in warehouses to streamline collaborative order picking tasks, significantly enhancing productivity and reducing human labor costs. However, efficient operation in such environments presents challenges, particularly in managing conflicts that arise when multiple AMRs simultaneously navigate shared narrow pathways. Such conflicts can cause delays and reduce overall system efficiency. Implementing effective Conflict-Free Pathing with Blocking (CFPB) strategies is essential to ensure smooth, collision-free operations while maximizing throughput.

This thesis addresses the challenge of optimizing path planning for AMRs by explicitly incorporating conflict-free blocking constraints. The study will focus on quantifying the trade-offs between routing efficiency, throughput maximization, and blocking constraints within collaborative order picking environments.

Research Objectives.

1. Formally define conflict-free blocking constraints within the context of AMR-based collaborative order picking.
2. Develop mathematical optimization models integrating blocking constraints into path planning frameworks.
3. Implement and evaluate heuristic, exact, and hybrid algorithms to optimize conflict-free path planning.
4. Analyze the impact of blocking constraints on operational efficiency, including metrics such as throughput, AMR utilization, and total operational time.

Zusätzliche Informationen

Bachelor / Master	Bachelor / Master
Betreuer	Julian Golak
Unternehmenspartner	-
Forschungsfrage	Design of algorithms that compute optimal path planning for AMRs by explicitly incorporating conflict-free blocking constraints

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Methodik und Implementierung	Algorithm Design, Programming
Literaturhinweise	[1] Gambella, C., Naoum-Sawaya, J., & Ghaddar, B. (2018). The vehicle routing problem with floating targets: Formulation and solution approaches. INFORMS Journal on Computing, 30(3), 554-569. [2] Zhang, W., Jacquillat, A., Wang, K., & Wang, S. (2023). Routing optimization with vehicle–customer coordination. Management Science, 69(11), 6876-6897.
Sonstige Hinweise	-