The acceleration of search in motion planning considering the dynamic characteristics of swarm AGVs

This study addresses the challenge of efficiently planning conflict-free paths for Automated Guided Vehicles (AGVs) in automated production and logistics environments, a task known as the Multi-Agent Path Finding (MAPF) problem. The conventional method [1], based on Conflict-based Search (CBS) [2], has been effective but struggles with long computation times, especially as the number of AGVs increases or in constrained spaces. To overcome these limitations, the study proposes integrating greedy search techniques and machine learning into the CBS framework, aiming for faster computation without sacrificing planning quality. Specifically, it replaces A* search with either a weighted version or a machine learning-enhanced version and substitutes best-first search with beam search. A novel machine learning model (Fig.1 left) predicts heuristic values for path planning, trained on simulation data from AGV operations. This approach demonstrated a reduction in computation time and the number of top expanded nodes, maintaining high-quality motion planning. Fig. 1 shows a comparison of the proposed method against traditional approaches, highlighting the efficiency gains and effectiveness of incorporating machine learning into AGV path planning within complex logistical settings. These improvements highlight the potential of machine learning to enhance the efficiency and effectiveness of AGV path planning in complex logistical settings [3].

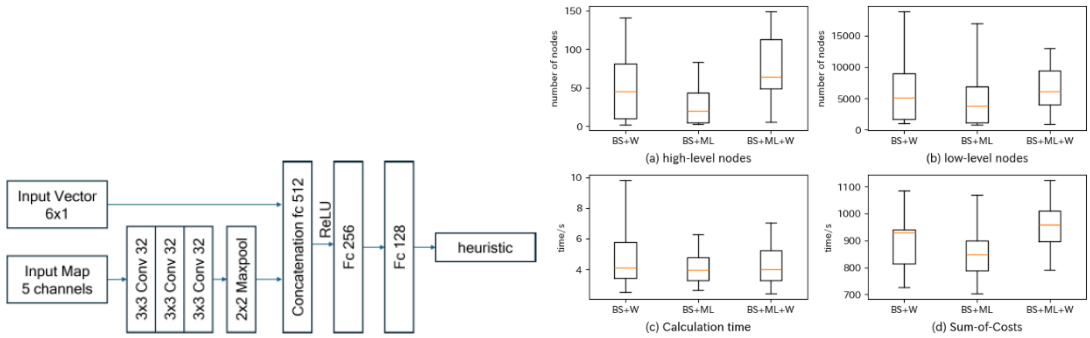

Fig. 1. Left: Proposed Model, Right: Simulation Results (BS: Beam Search, ML: Machine Learning, W: Weighted A* Search)

Keywords: Automated Guided Vehicle, Motion Planning, Multi-Agent Path Finding

References

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