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Mitigating Emergency Stop Collisions in AGV Fleets in Case of Control Failure

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Automated guided vehicles (AGVs) are an essential area of research for the industry to enable dynamic transport operations. Furthermore, AGV-based multi-robot systems (MRS) are being utilized in various applications, e.g. in production or in logistics. Most research today focuses on ensuring that the system is operational, which is not always achieved. In daily use, faults and failures in an AGV-based MRS are most likely inevitable. So industrial systems must support some safety methods, e.g. an emergency stop function. Although emergency stop functions are designed to prevent larger issues, their usage leads to a failure of the control system, since the affected systems are typically shut down immediately. Depending on the AGV type, an uncontrolled behaviour can occur. In case of control failure, this behaviour can lead to collisions and associated high costs. In this paper, we present and compare three approaches for avoiding collisions in an intralogistics scenario in the case of control failure. In the said scenario, the trajectory planing is being adapted to minimize or avoid collisions. The first approach calculates the next collisionfree time slot when an emergency stop occurs and continues the planned trajectories until this time. The second approach calculates several alternative trajectories with the existing trajectory planning without considering emergency stop collisions. The third approach aims to completely avoid emergency stop collisions by extending trajectory planning to include the detection of possible emergency stop collisions. We evaluate and compare the approaches by employing multiple metrics to assess their performance, including runtime, number of collisions that occur, and the system's throughput. We thoroughly discuss and analyse the results, offering insights into the strengths and weaknesses of the approaches.

Type of presentation

Invited Talk

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