Towards a Flexible and Scalable Transportation in Distribution Centers

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1 Introduction

Transportation in modern distribution centers must be fast and reliable, robust against faults, and flexible and scalable to the dynamics of the transportation. One way to achieve these requirements is to replace conventional conveyor system with a group of autonomous mobile robots. In this work we show benefits of this approach in simulation. The investigation is an extension of the result presented in [1].

2 Control Approach

We propose a control hierarchy shown in Figure 1. The high-level control assigns to each robot a reference trajectory. The low level control is responsible for accurate tracking of this trajectory and avoidance of collisions between the robots and obstacles.

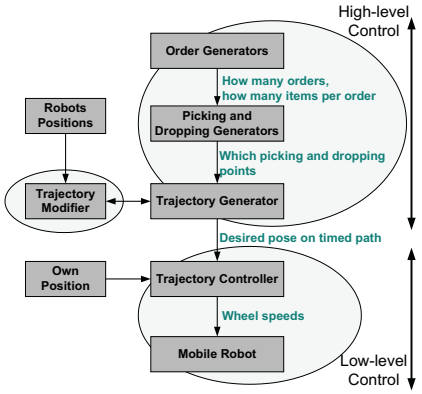

Figure 1: Control Hierarchy

3 Case Study

As a case-study, we consider an automated distribution center shown in Figure 2. Here, we replace a part of the conveyor system with mobile robots and study impact of different geometric paths in combination with different local-priority rules.

4 Simulation Results

Figure 3 illustrates how the throughput of the system, represented by the time needed to complete all transportation tasks, $t_{complete}$, is affected in different combination of paths and priority rules. From Figure 3 we conclude that the control architecture given in Figure 1 can handle different number of robot, thus the scalability is achieved. This consequently allows us to increase or decrease the throughput in a simple way. The ability to cope with different geometric paths implies flexibility to adapt the dynamics of the system and accommodate different high- or low-level control strategies.

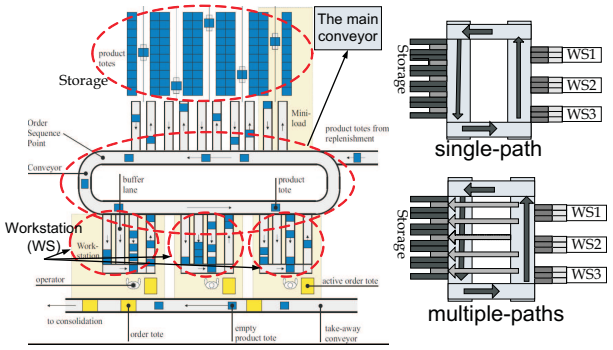

Figure 2: An Automated Distribution Center. At the right side are shown two possible geometric paths of the robots

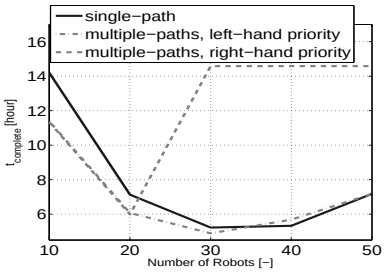

Figure 3: Comparison of $t_{complete}$. The priority means that at the junction robots that come from the right or left side of the other robots get higher priority

References

[1] S. Adinandra, *et al.*, "Performance of High-level and Low-level Control for Coordination of Mobile Robots," *Proc. 7th Int. Conf. on Informatics in Control, Automation and Robotics*, Funchal, Madeira, pp. 63-71, 2010.

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