

Control Methodology of Two Stacker Cranes in Automated Storage/Retrieval System

We propose control methodology of two stacker cranes to avoid collisions in an automated storage/retrieval system including the constraint on trajectories caused by dynamics as shown in Fig. 1.

In the automated storage/retrieval system environment, there are three problems: constraint on trajectories caused by dynamics (e.g., vibration control), safety in the case of an emergency stop, and practical calculation time. In the proposed method, the motion is planned through two approaches. In the first approach, the trajectories of cranes are chosen from candidates that satisfy the constraint on dynamics and are checked to determine whether the selected trajectory ensures safety in case of an emergency. The calculation cost is reduced by confining the candidate trajectories using the characteristic of the number of cranes. If a collision cannot be avoided in the first approach, we adjust the confined candidate trajectories and find a suboptimal trajectory. The techniques used in the second approach are to delay the movement of cranes and to generate detours. Concretely, we set a via point on the line which is normal to the line between the current position of a crane and the collision point on the original trajectory, and the line is set to pass the collision point (Fig. 2). In the simulation, the working efficiency of the evaluated method is calculated as the ratio of the work time of a single crane to that of the method. The simulation results are shown in Table 1. The working efficiency is 1.98 when collision is ignored, 1.68 in a simple method, and 1.85 in the proposed method. If collision is ignored, the working efficiency is almost doubled compared to the case of a single crane. The results show the effectiveness of the proposed method.

Keywords: Motion Planning, Stacker Crane, Heuristics.

Reference

1) Hisato Hino, Yoshimasa Kobayashi, Toshimitsu Higashi and Jun Ota, Control Methodology of Stacker Cranes for Collision Avoidance Considering Dynamics in a Warehouse, *Proceedings of the 2009 IEEE International Conference on Robotics and Biomimetics (ROBIO 2009)*, 983/988 (2009).

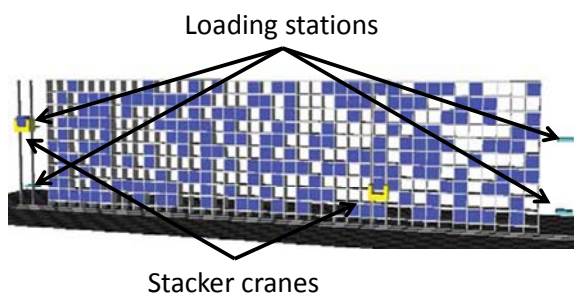


Fig. 1 An automated storage/retrieval system with two stacker cranes

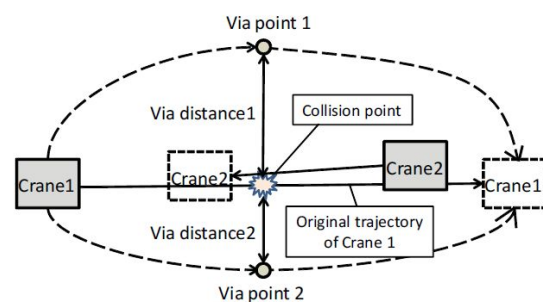


Fig.2 A technique to derive the via points

Table 1: Simulation results

	Work time (min.)	Working efficiency	Movement distance (km)	Waiting time (min.)
Single crane	15.49	1.0	2.43	0
Ignore collisions	7.83	1.98	1.25	0
Simple method	9.21	1.68	1.30	1.28
Proposed method	8.39	1.85	1.24	0.50