Motion Planning of Two Stacker Cranes in a Large-Scale Automated Storage/Retrieval System

We propose a method for reducing the computational cost of motion planning of warehouse equipped with two stacker cranes (Fig.1). There is a former research studied the motion planning of an automated storage/retrieval system with two independent stacker cranes [1]. While the loading efficiency of the algorithm it proposed is satisfied, calculating the feasible trajectory requires a significant amount of time, which does not satisfy the requirement of industry. In other words, the load to be transported is assigned randomly, so we cannot do trajectory calculation beforehand.

We propose a method for reducing the computational time of motion planning for stacker cranes [2]. Most automated storage/retrieval systems are only equipped with one stacker crane. However, this is logistically challenging, and higher work efficiency in warehouses, such as those using two stacker cranes, is required. In this paper, a warehouse with two stacker cranes working simultaneously is proposed. Unlike warehouses with only one crane, trajectory planning in those with two cranes is very difficult. Since there are two cranes working together, a proper trajectory must be considered to avoid collision. As transport works in automated storage/retrieval systems are occurring randomly, motion planning cannot be conducted in advance. Planning an appropriate trajectory within a restricted duration would be a difficult task.

As a solution, we propose a “free-step” and a method to choose trajectories that are more likely to avoid collision. We thereby address the current problem of motion planning requiring extensive calculation time. For employment in an actual industrial warehouse, we must reduce the calculation time of the automated storage/retrieval system.

References

[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).

[2] Yiheng Kung, Yoshimasa Kobayashi, Toshimitsu Higashi, and Jun Ota, Motion Planning of Two Stacker Cranes In A Large-Scale Automated Storage/Retrieval System, Proceedings of the 2011 IEEE Int. Conf. Robotics and Biomimetics (ROBIO2011), 168/173 (2011).

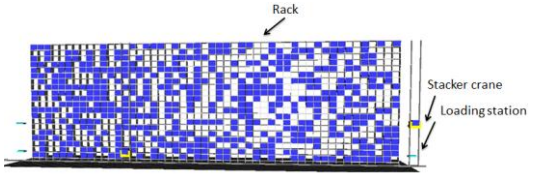

Fig. 1 Automated storage/retrieval system with two stacker cranes

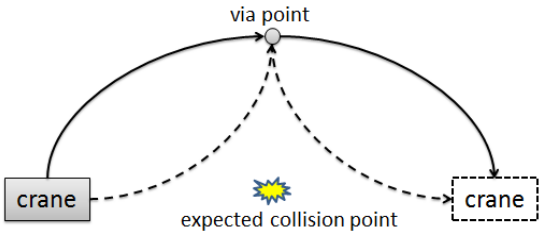

Fig. 2 Derivation of the order of collision verification in a detour avoidance trajectory