Point-to-Point Multiple-Goal Task Realization in Robot Arm and Positioning Table

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The point-to-point multiple-goal task is essential in manufacturing industries. This task can be found in assembly, spot-welding, and the like. The main concern in this task is to minimize the task completion time since it means less time wastage and high productivity. Realizing this task using a robot arm-based system is highly complicated due to several design methods such as motion planning, collision avoidance, and goal rearrangement along with the kinematic and dynamic constraints of the system.

In this study, the system is comprised of a 6-DOF robot arm and a 1-DOF positioning table (Fig. 1). The robot arm has to reach goals while the table positions the object. Since the system is redundant, the collision is avoided through motion coordination allowing for straight-line motion in configuration space of robot arm and table. To reduce the task completion time, the goal rearrangement and motion coordination are solved simultaneously (Fig. 2). A hybrid search method (HSM) combining the nearest neighbor method (NN) and the Dijkstra method (DM) is proposed and shown effective in solving goal rearrangement with motion coordination (Fig. 3, 4).

References

1) Lounell B. Gueta, Ryosuke Chiba, Jun Ota, Tamio Arai, Tsuyoshi Ueyama, "Design and Optimization of a Manipulator-based Inspection System," the Society of Instrument and Control Engineers Transaction on Industrial Application, vol. 6, no. 6, pp. 41-51, 2007.
2) Lounell B. Gueta, Ryosuke Chiba, Jun Ota, Tamio Arai, Tsuyoshi Ueyama, "Coordinated Motion Control of a Robot Arm and a Positioning Table with Arrangement of Multiple Goals," Proc. of the IEEE Int'l. Conf. on Robotics and Automation, (to appear) 2008.

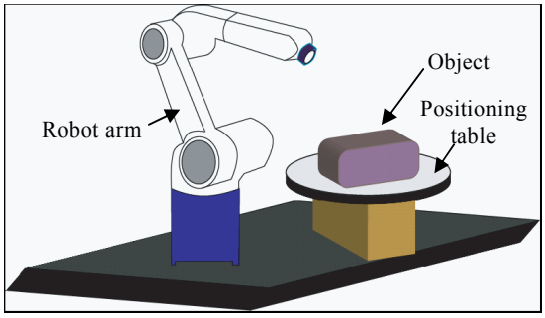

Fig. 1 A system with robot arm and positioning table

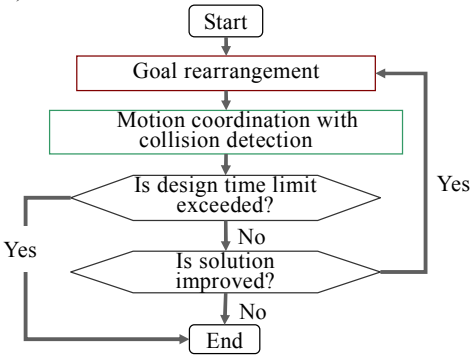

Fig. 2 Flowchart of the proposed solution

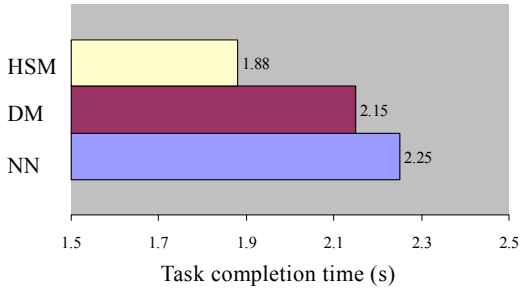

Fig. 3 Comparison of various search algorithms. Goal arrangement with motion coordination can take very long design time. In HSM, however, the solution, better than NN or DM, is obtained within 30 minutes.

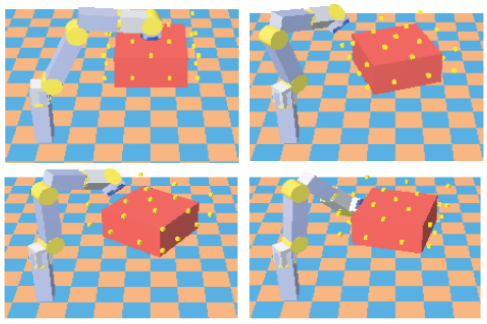

Fig. 4 Snapshots of the simulation done. The goals of robot arm are shown in yellow dots