

Selection of Manipulator System for Multiple-Goal Task by Evaluating Task Completion Time and Cost with Computational Time Constraints

Task completion time and cost are two significant criteria for the selection of manipulator system. For a given task, several Pareto solutions of manipulator systems should be derived based on evaluation of these two criteria. However, a large computational time is required to evaluate these two criteria for all candidate manipulator systems.

In this study, we propose a method (Fig. 1) that can select Pareto solutions of manipulator systems by evaluating task completion time and cost within the desired computational time [1]. Selection of manipulator is taken into account in manipulator system selection since task completion time and cost are affected greatly by the selected manipulator. Each candidate manipulator system consists of a 6-DOF robot arm, a 1-DOF positioning table, and a tool (Fig. 2). The structure configuration of manipulator system (connective relationship among system components) is taken into account. In the proposed method, multiple objective particle swarm optimization (MOPSO) is employed to search for appropriate manipulator systems with structure configuration from a set of candidate systems. Location optimization and motion coordination are integrated to derive the task completion time. We employ particle swarm optimization (PSO) for location optimization and use nearest-neighborhood algorithm (NNA) for motion coordination. The proposed method is proved to be effective in a comparison of 3 methods that involve a random search algorithm for 5 different tasks. The computational time for each method is 1 hour. Retrieval performance evaluation (F value) is used to evaluate all methods. The F value derived by using the proposed method is improved on average by 72.4% relative to the results of the other methods (Fig. 3).

Keywords: Manipulator system selection, MOPSO, task completion time, location optimization

Reference

[1] Y. J. Huang, L. B. Gueta, R. Chiba, T. Arai, T. Ueyama, M. Sugi and J. Ota, Manipulator system selection based on evaluation of task completion time and cost, in Proc. IEEE/RSJ Int. Conf. on Rob. and Sys. pp. 4698-4703 (2011)

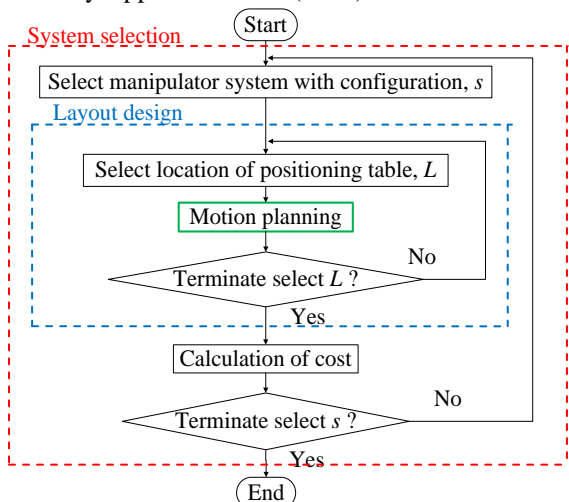


Fig. 1 Proposed method

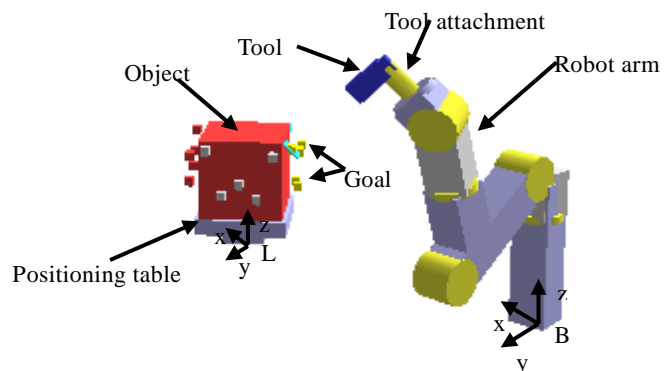
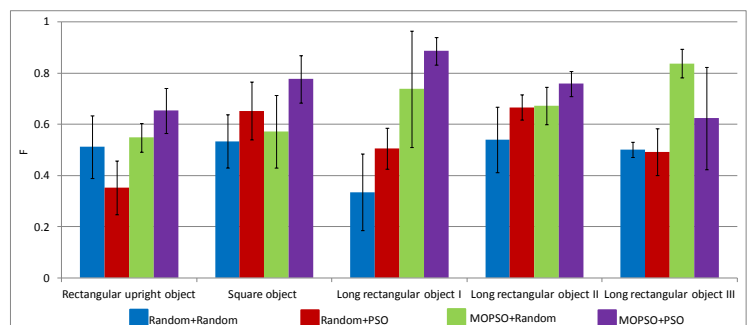


Fig. 2 A system with a robot arm, a positioning table and a tool



6 Fig. 3 The F value derived by 4 different methods for 5 tasks