Rearrangement Task using Multiple Mobile Robots

Rearrangement tasks involving multiple objects are the fundamental for mobile robots. Robots transport objects from an initial to a goal configuration as shown in Fig.1. These tasks have various applications, for example, production system, transfer machine, room cleaning machine, etc. The goal is to realize the fast and effective rearrangement tasks in the environment with many obstacles such as objects and walls.

To solve the problem, there are 2 important points to be considered. (a) the method in determining the delivery positions, (b) the method in deciding efficient task assignment and path planning. In order to cope with (a), delivery positions are set up in the neighborhood of narrow corridor where only on robot can pass by to reduce extra delivery tasks. For (b), we derived a Meta-Heuristic based on Simulated Annealing method to find sub-optimal solution in practical time. The task completion time is used as an evaluation function. The rearrangement problem is modeled as k-Stacker Crane Problem (k-SCP). Then, an order of tasks and paths of robots are determined by using heuristics to solve k-SCP as shown in Fig.2.

In the simulation, the proposed method is compared with 2 kinds of methods which are continuous transportation method and Territorial Approach. The simulation results indicate that the proposed method achieves the least task completion time in all simulation environments. The results of simulation using 3 robots with 10 objects are shown in Fig.1. Moreover, the real experiment show that our system can still operate accurately even there is the sensor error from sensing the environment. These results reflect the effectiveness of our proposed method.

Keywords: Rearrangement problem, Multiple mobile robots, Multiple objects

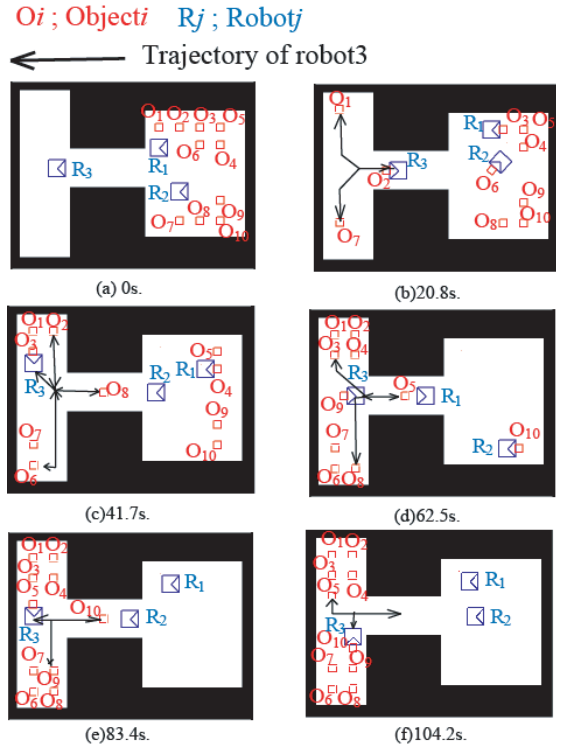

Figure 1: An example of rearrangement tasks using the proposed method

Reference

1) Naoki Oyama, Zhaojia Liu, Lounell B. Gueta and Jun Ota, Rearrangement Task of Multiple Robots Using Task Assignment Applicable to Different Environments, Proc. IEEE International Conference on Robotics and Biomimetics, pp. 300-305 (2010).

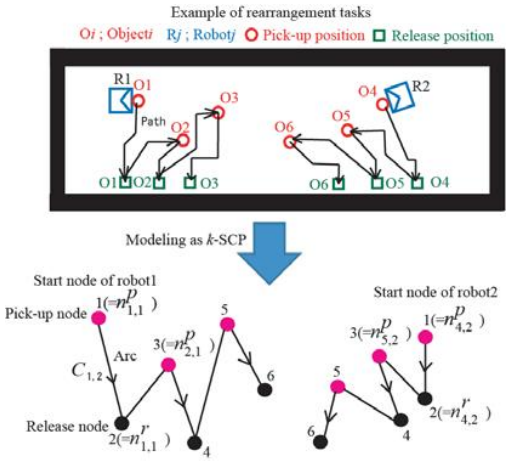

Figure 2: k-SCP problem in the rearrangement task