Motion Planning of Multiple Robots by Considering Robot Fatigue (Prof. T. Arai)

Robot manipulators used in industrial lines are required to work continuously for long durations. In order to develop a stable system comprising robots, an important factor that needs to be considered is the heat generated at the actuators of robots. Because of high-speed and continuous motion of the robots, this heat increases with their movement. If some actuators get overheated, the robot halts; this causes a drop in the efficiency of the system.

In this study, we consider a high-speed handling system comprising multiple robots (Fig. 1). Further, we optimize robot motions and a task allocation algorithm in order to control the actuator heat and improve the efficiency of the entire system. Because of the short durations of the robot motions in this system, a state-action map is used; this map comprises a lookup table that connects the state of a robot and the system to an appropriate robot action. The state-action map is developed in advance so that the robot can decide its actions by just referring to the map. The appropriate motion for picking up a component is determined by optimizing the initial and final positions of the robot's hand using dynamic programming. The task allocation algorithm is optimized by reinforcement learning in order to balance the task load between the robots and control the heat generated while performing the allocated task. The efficiency of the system improves by 70% when the developed state-action map is used.

Keywords: Robot fatigue, State-action map, Dynamic programming, Reinforcement Learning

References

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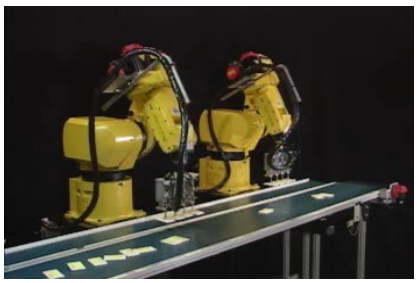

Fig. 1 Handling system with multiple robots

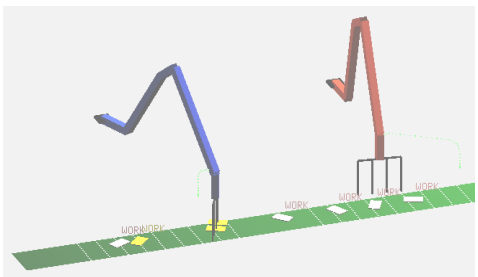

Fig. 2 Simulator of a handling system

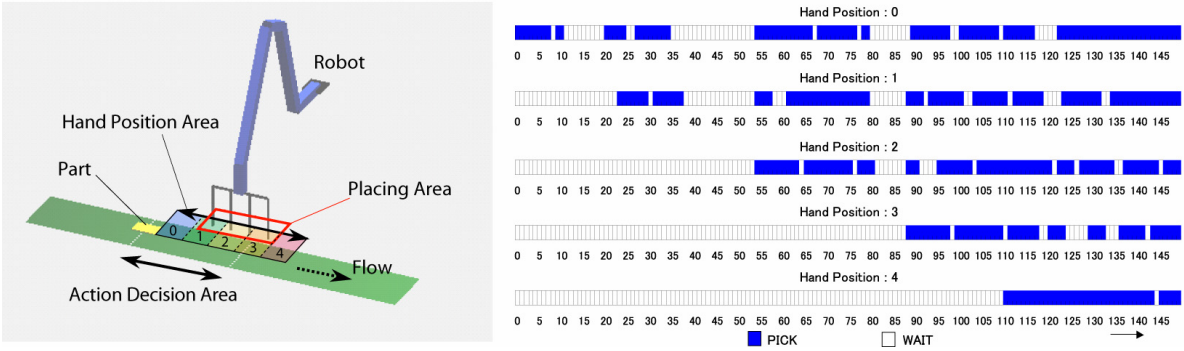

Fig. 3 Developed state-action map for picking up a component