Design of Force Control Parameters for Cycle Time Reduction

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Recently, in manufacturing industry, robots are required to achieve complicated assembly operations like those human workers perform. Force control plays a significant role in robotic assembly operations, in which manipulated objects contact with the environment. In order to achieve successful operations, force control parameters must be designed appropriately. Here, it should be noted that reducing a cycle time, which is the time required to complete an operation, is very important in industrial applications. Therefore, force control parameters that can reduce the cycle time and achieve operations successfully are desired greatly.

In this research, we have proposed a method for designing force control parameters considering the cycle time. In the method, sub-optimal control parameters are obtained through iterative simulations of assembly operations because it is difficult to calculate the cycle time analytically. This method is formulated as a nonlinear constrained optimization problem whose objective function is the cycle time (Fig. 1).

We applied the method to peg-in-hole operations and clutch assembly. First, we developed simulators based on preliminary experiments (Fig. 2, Fig. 3). Then, we solved the optimization problem using the simulator and obtained sub-optimal control parameters that can reduce the cycle time. The validity of the obtained parameters has been demonstrated by experimental results.

Keywords: Cycle Time, Force Control, Admittance, Robotic Assembly, Optimization

References

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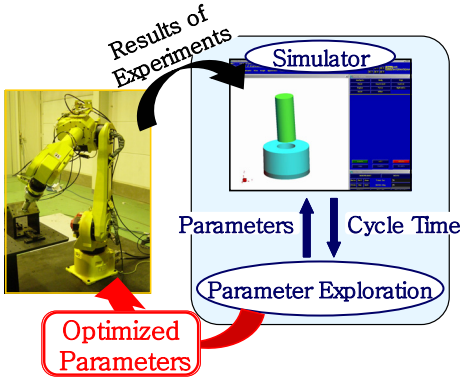

Fig. 1 Schematic View of Designing Force Control Parameters

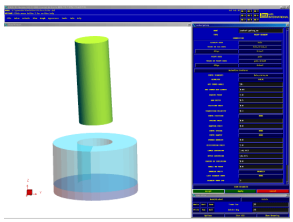

Fig. 2 Simulator for Peg-in-Hole Operations

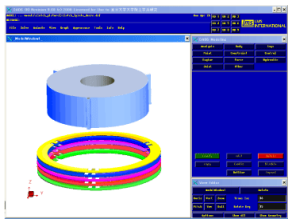

Fig. 3 Simulator for Clutch Assembly