# Design of Force Control Parameters Considering Cycle Time

(Prof. T. Arai and Lecturer Y. Maeda (Yokohama National Univ.))

Recently, in manufacturing industry, robots are desired 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 shortening the cycle time, which is the time required to complete an operation, is very important in industrial applications. Therefore, force control parameters that can shorten the cycle time and achieve operations successfully are desired greatly.

Thus, we proposed a method for designing force control parameters required in industry. In the method, we obtain sub-optimal control parameters through repetitive simulation of assembly operations in order to estimate the cycle time 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 assembly of clutch. First, we developed simulators based on preliminary experiments (Fig.2, Fig.3). Next, we solved the optimization problem using the simulator. Through the method, we obtained sub-optimal control parameters that can shorten the cycle time.

*Keywords*: Cycle Time; Damping Control; Admittance; Robotic Assembly, Optimization

## References

1) Natsuki Yamanobe, Yusuke Maeda, Tamio Arai: “Designing of Damping Control Parameters for Peg-in-Hole Considering Cycle Time,” IEEE International Conference on Robotics and Automation, 2004.
2) Natsuki Yamanobe, Yusuke Maeda, Tamio Arai: “Design of Damping Control Parameters for Assembly of Clutch Considering Cycle Time,” ROBOMEC04 (In Japanese).

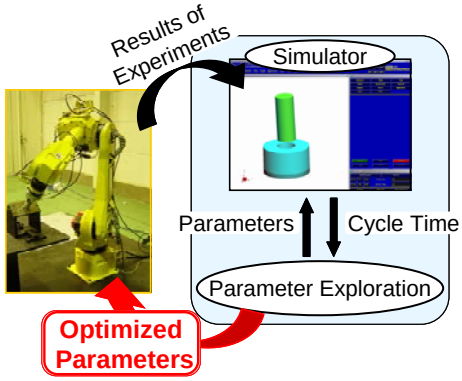


Fig. 1 Schematic View of Designing Force Control Parameters

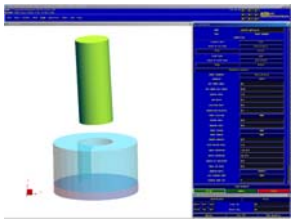

Fig. 2 Simulator of Peg-in-Hole Operations

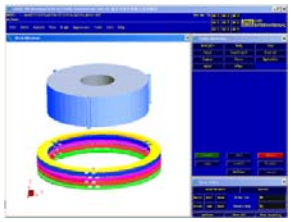

Fig. 3 Simulator of Assembly of Clutch