Cognitive Integrated Motion Generation for Environmental Adaptive Robot

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Recently, active researches have been performed to increase a robot's intelligence so as to realize the dexterous tasks in complex environment such as in the street or homes. However, since the skillful human-like task ability is so difficult to be formulated for the environmental adaptive robot, not only the analytical and theoretical control researches but also the direct human motion mimetic approach is necessary. Although otherwise various techniques for generation of imitational behavior is proposed, many of these researches are designing movement of a robot by imitation of human movement, and they are not mentioned about the technique of correcting motion, using the cognitive information acquired during motion.

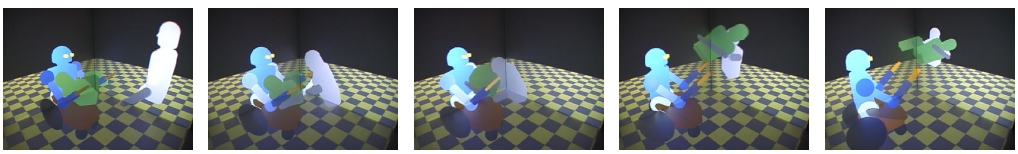
In this paper, our goal is making a robot the dynamic interaction with complicated environment such as "holding a human in its arms". Only by making a robot imitate human's trajectory of motion simply, the robot will fail in the dynamic interaction with complicated environment. We propose that to realize the environmental interactive task, it is insufficient to replay the human motion along. We show a novel task learning approach to integrate the cognitive information into the mimic of human motions so as to realize the final complex task by the robot.

In the first, motion of human being is measured and motion model is generated using DP. Motion of human is measured using the 3D Immersion-type dynamic simulation environment proposed by our group as shown in Fig. 1 (a). Although dynamic interaction with environment was realized using the virtual subject who follows a real human subject, in this research we regard a virtual subject as a controlling robot and a real human subject gives the teaching motion of holding. The vision and tactile information at the time of performing a task can be observed on real time, and not only a trajectory of motion but also the recognition information acquired during the task can be given to a robot.

In order to succeed a holding task, it is necessary for robot to not only imitate human motion, but also adjust generation motion using recognition results such as position of a dummy doll. So, generated imitation motion using the motion model is spatiotemporal adjusted by recognition information.

To evaluation of our proposal method, we have experiments which a robot operated holding task under some conditions as shown in Fig. 1 (b).

(a) Example of real human movement.



(b) Imitaion behavior after spatiotemporal adjustment.

Fig. 1: Experimental results.