TWO METHODOLOGIES TOWARD ARTIFICIAL TACTILE AFFORDANCE SYSTEM IN ROBOTICS

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Abstract-If the theory of affordance is applied to a robot, performing the whole process of recognition and planning is not always required in its computer. Since the tactile sensing of a robot is important to perform any task, we focus on tactile sensing and introduce a new concept called the artificial tactile affordance system (ATAS). Its basic idea is the implementation of a recurrent mechanism in which information obtained from the object and the behavior performed by the robot's inducing the next behavior. We intend to implement ATAS based on the following two methodologies: (1) after each rule is transformed into an algorithm, a program module is coded based on the algorithm; ATAS is composed of several program modules, and a module is selected from the set of modules based on sensor information; (2) a set of rules is expressed as a table composed of sensor input columns and behavior output columns, and the table rows correspond to rules; since each rule is transformed to a string of 0 and 1, we treat a long string composed of rule strings as a gene to obtain an optimum gene that adapts to its environment using a genetic algorithm (GA). For methodology 1, we established an ATAS composed of 3 to 5 modules to accomplish such tasks as object grasping, pick and place, cap screwing, and assembling. Using methodology 1, a two-hand-arm robot equipped with an optical three-axis tactile sensor performed the above tasks. For methodology 2, we propose the Evolutionary Behavior Table System (EBTS) that uses a GA to acquire the autonomous cooperation behavior of multiple mobile robots. In validation experiments, three agents equipped with behavior tables conveyed an object to a specified goal with higher scores than the four-agent condition. Since the redundant agent does not interrupt the other agents, the agent acquires the collective behavior of not interrupting other agents based on its environment information. Methodology 1 is very effective for such fine control as handling tasks of humanoid robots, and methodology 2 is very useful to obtain general robotic behavior that is suitable for the environment.

Index terms*: Affordance, Tactile sensor, Three-axis, Collective robot, Evolution, Behavior, Genetic algorithm