Abstract of Dissertation

Pseudo Planning for Immediate Response
(状況的行為に基づいた即応計画手法)

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The approaches to make an agent decide the proper actions for achieving the goal might be roughly categorized into two groups - the planning and the situated action approach. It is well known that each system has its own strength and weakness with its own application areas. In particular, since, unlike the planning, the situated action approach is to derive not the complete course to the goal, but only the currently closer state to the goal and the action to accomplish it at every situation, the computational requirement could be reduced compared with the classical planning. Numerous scientific applications which adapt this notion have followed, and usually showed the faster response time in deriving currently proper actions for achieving the goal. As a result, this fast runtime makes the situated system be well situated than the classical planner in the dynamic and unanticipated environment, and moreover, the remaining resource derived by the fast runtime could be used in more important tasks such as learning and recognizing the situation. However, although the closer state to the goal for deriving the situated action would be easily calculated in spatial reasoning, it might be comparatively difficult to derive it in logical reasoning. Therefore, most of practical applications of the situated action have been restricted to those fields such as the navigation of mobile robots, and not directly handled general logical problems that have been dealt by the classical planning.

This dissertation first presents the new perspective for designing the intelligent agent, which the agent should be built based on the notion of situated action. Moreover, since the symbolic expression is necessary to simulate and realize intelligence, we also provide the new point of view that situated action should be represented in symbols.

And then, for reflecting the design methodology, we propose a novel action selector to situatedly extract a set of actions, which is likely to help to achieve the goal at the current situation, from the relaxed propositional space. After applying the set of actions, the agent should recognize the new situation for deciding the next proper set of actions. By repeating this procedure, the agent is expected to arrive at the goal state. The

experimental result in some planning domains shows that the quality of the resultant path to the goal is mostly acceptable as well as deriving the fast response time. This approach could therefore make the agent be well situated in solving the complicated tasks given in propositional logic, and moreover effectively recognize and learn the situation by using the remaining resource.

However, since those actions are derived from the relaxed space in which roughly considers the planning problem, this method can be applied only in the deadlock free domain where fatally wrong decisions cannot be made. Hence, this dissertation proposes two novel notions to make the agent deal with the deadlock problem: hybrid architecture based on the situated action selector, and situated imagination. The former is to combine the situated action selector with the conventional planner, which the situated action selector requests the conventional planner to derive the proper action only when the agent is regarded to meet the deadlock. The approach for the latter situated imagination makes the pure situated action selector deal with most of the deadlock problems without the help of the conventional planner. The agent with the latter approach could avoid meeting the deadlock through imaging lookahead states. In the experimentations performed on various planning benchmarks, although both approaches still show the fast runtime solving the deadlock or deadlock free problems, the planning quality heavily depends on the given planning problem.

We also propose the structural model of the planning problem by examining those dependencies. We believe the planning problem has its own distribution of lumps of deadlocks, and furthermore the development of the algorithm to learn the structures, which are the form of the distribution of them, is one of the most important issues in building the intelligent agent and understanding our decision making in everyday life.