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Title	マルチエージェント系における組織学習を用いた動的 環境への適応に関する研究
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Citation	
Issue Date	2001-03
Туре	Thesis or Dissertation
Text version	author
URL	http://hdl.handle.net/10119/723
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The adaptive learning based on organization learning for dynamic environment on multi-agent system

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February 13, 2001

Keywords: Multi-Agent System, Soccer Simulation Game, Adaptive Learning, Organizational Learning.

The research of learning of the agent had aim that was improvement of the action diction ability. In addition, the learning of multi-agent system had same aim. In the field of the learning on multi-agent system, its design of the learning model for organization, which consist of many agents, are used by information sharing or distribute acquisition reward. However, the purpose of these learning models was the construction of the cooperation system by the ability adjustment of the agent. Moreover, these are adapted to the environment, which changed dynamically, by forgetting it was learned once. It's forgetting has the reason with a lot of uselessness, why all members memorize learning data. Nevertheless, its forgetting is problem for the agent.

The agent cannot know all situations in own environment, so that it is difficult to recognize the change in its environment for it. Because, the forgetting is meaning of the creating knowledge of adapting to new environment for the agent. Therefore, the case of when the agent knew own knowledge is not useful, it must use old knowledge until created new knowledge, which is adapting to new environment. Moreover, the agent needs to learning many times in the environment, which experienced once. The reason is the forgetting the old learning data. These are problem for the society basic system, which is needed safety and stability.

In this research, we proposed new learning system for multi-agent system to solve the problem, has the purpose was improvement of the agent's action decision ability, of agent's learning. Its learning model solves the problem is learning delay which happened because of forgetting and surely adjusts to the change in dynamically environment. Concretely, it uses organizational learning in organization theory for multi-agent system. The purpose of this technique in this report is three points, as follows:

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- 1. The convergence of learning in short time(in real time) by learning experience sharing.
- 2. Dynamical organization formation according to a change in the stuation.
- 3. Operation of phase change of organization according to a change in the environment.

We proposed, in this report, the method of reinforcement learning, which used the pair of scenario and action as learning data, in partial observable environment and the model of organizational learning, in multi-agent system, which is sharing learning source with under level agents used by upper level agent. Moreover, the upper level agent sets standard model of under level agent, according to in various environment, by analyzed the environment. This learning model was evaluated by implemented soccer team and gamed it. At that time, we used multi-agent soccer simulator of the RoboCup. Consequently, our organization-learning model for multi-agent system was effective for the learning of agent, as shown Figure 1 and Figure 2.



Figure 1: The result of learning, games with same team, of Personal Learning(PL Team) and Organizational Learning(OL Team): The vertical axis means score difference and the horizon axis mean game number.



Figure 2: The result of learning, games with difference team, of Personal Learning(PL Team) and Organizational Learning(OL Team): The vertical axis means score difference and the horizon axis mean game number.