

Title	自然言語を理解するソフトウェアロボットの適応的行動生成
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Citation	
Issue Date	2008-03
Type	Thesis or Dissertation
Text version	author
URL	http://hdl.handle.net/10119/4296
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Generation of Adaptive Behavior for Software Robots Understanding Natural Language

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February 7, 2008

Keywords: Communication robot, Situation awareness, Natural language, Case-based reasoning, Interrupt command, unknown word.

The purpose of a present robot research is classified into the development of the task aim robot that does only specific work in limited environment such as factory etc., and the development of the communications aim robot that works cooperatively with man in open environment like man's daily life. As for the communications aim robot, not to execute specific task but to dialogue with people and to recognize one another's existence is requested. The garbage transportation robot and the guard robot, etc. are operated in the hospital and the building now. And robots are expected to work at the place that is nearer to man's life in the not-so-distant future.

A current robot only had to execute the instruction on the street because given instructions were decided. However, when the robot advances to man's daily life space, and the chance to act with man increases, man's instruction is requested to be understood in various environments. It is demanded to consider information that exists in memory of past experience and to act in an unknown situation that is impossible to have knowledge necessary for action beforehand. Study and the adjustment that acquires an autonomous action are needed for that. Because it is a robot that coexists with man, it is requested to use the interaction with the user to learn. Promoting autonomy is requested as experience enlarges through the interaction with the user. Moreover, the conversational function by

the natural language that is a natural interface for man is important in the system that provides service while communicating with man. Because the natural language is the most natural conversation method, the achievement of the system that understands the natural language is requested. It can be said that act by understanding the natural language is necessary for robot to spread widely.

In this research, I proposed a way of robot to act by imperative sentence of natural language and learn action that adjust in changing environment. The feature of this research is that the robot learns autonomous acts by the conversation with the user. The following three were taken up in this research as a problem that should be solved for that. The first problem is that there is an interrupt input from the user while the robot is executing the instruction. In this case, the robot should autonomously judge whether the instruction currently being executed or the interrupt instruction is important and decide execution sequence. The second problem is that the user inputs the instruction including an unknown word. In this case the robot should learn the meaning of the unknown word by deducing the meaning of the word and ask user for it. The third problem is that the robot cannot act autonomous. The robot should analogize the action that should be taken according to the situation and learn it.

In this research, Case-based reasoning was used as a technique for the robot to learn action. Case-based reasoning is framework that accumulates a lot of cases, and searches the case with a similar event for a certain problem, and correct that to suits the problem, and apply the case corrected to solve problem. Moreover, it can be said it 's a in real time suitable action learning way because of the case that is experienced and obtained can be accumulated and applied without needing many process, and it has an advantage that can obtain the case example of action without any previous knowledge using case base. In this research, the action record of the robot was used as a data base for reasoning. And, proposed three action generation algorithms of interrupt processing and learning unknown word and analogy of action, and considered it. In the interrupt processing, "Importance degree " was defined as degree of which shows how important it is from other instructions compared by, and " Execution degree " was defined as degree of which shows how robot made judgment to give preference to

instruction that should be executed, and they were made to be learned by the instruction and the evaluation from the user so that adaptive action generation was enabled for the interruption input. In the learning unknown word, when the unknown object name was given, robot ask user by using attribute information of target object and learn synonym. When an unknown instruction name was given, robot ask user by guessing from instruction which syntax is similar, or guessing from past instruction in action record which was used for the same usage, and learn synonym.

And, the simulation system that mounted these adaptive action generation algorithms was constructed and verified. The system arranged the robot on the simulation environment, generated the action of robot by input of user 's natural language, and displayed it in animation. Moreover, each expression defined for the adaptive action generation algorithm was verified. And, it was shown that robot learn to enable autonomous behavior, and learn unknown word by accumulating action records.