

# Symbol Emergence in Robotics for Modeling Human-Agent Interaction

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## ABSTRACT

Human intelligence is deeply dependent on its physical body, and its development requires interaction between its own body and surrounding environment including other agents. However, it is still an open problem that how we can integrate the low level motor control and the high level symbol manipulation system. One of our research goals in the area called “symbol emergence in robotics” is to build a computational model of human intelligence from the motor control to the high level symbol manipulation. In this talk, an unsupervised on-line learning algorithm, which uses a hierarchical Bayesian framework for categorizing multimodal sensory signals such as audio, visual, and haptic information by robots, is introduced at first. The robot uses its physical body to grasp and observe an object from various viewpoints as well as listen to the sound during the observation. The basic algorithm for intelligence is to categorize the collected multimodal data so that the robot can infer unobserved information better and we call the generated categorizes as multimodal concepts. The latter half of this talk discusses an integrated computational model of human intelligence from the motor control to the high level cognition. The core idea is to integrate the multimodal concepts and reinforcement learning. Furthermore, this talk attempts to model communication within the same framework since the self-other discrimination process can be seen as the multimodal categorization of sensory-motor signals.

## ACM Classification Keywords

I.2 ARTIFICIAL INTELLIGENCE

## Author Keywords

Symbol emergence; language acquisition; human-robot interaction; mental model of others

## BIOGRAPHY

Takayuki Nagai received his BE, ME, and Ph.D. degrees from the Department of Electrical Engineering, Keio University, in 1993, 1995, and 1997, respectively. Since 1998, he has been with the University of Electro-Communications where he is currently a professor of the Graduate School of Informatics and Engineering. From 2002 to 2003, he was a visiting scholar at the Department of Electrical Computer Engineering, University of California, San Diego. He concurrently serves as a professor at the UEC Artificial Intelligence eXploration Research Center (AIX), a visiting researcher at AIST AIRC, and a visiting researcher at Tamagawa University Brain Science Institute. He has received the 2013 Advanced Robotics Best Paper Award, etc. He is a member of the IEEE, RSJ, JSAI, IEICE and IPSJ.



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