An Approach from Motion Generation/Recognition to Intelligence based on Mimesis Principle

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1. Introduction

The discovery of mirror neurons[1] have been a notable topic of brain science. Mirror neurons, which have been found in primates' brain, fire when the subject observes a specific behavior and also fire when the subject start to act the same behavior. Furthermore, it is located on Broka's area which has close relationship between language management. The fact suggests that the behavior recognition process and behavior generation process are combined as the same information processing scheme, and the scheme is nothing but a core engine of symbol manipulation ability. Indeed, in Donald's "Mimesis Theory"[2], it is said that symbol manipulation and communication ability are founded on the behavior imitation, that is integration of behavior recognition and generation.

Imitation behavior by human is not simple trajectory imitation but recognition of other's mind and performance of the behavior by his/hers own will. For such imitation, two processing; abstract of the other's behavior into symbol representation and generation of motion from the symbol, are needed. We think that a breakthrough idea for intelligence emergence is existed in the combination of motion recognition and generation.

In this paper, we propose a mathematical model that abstracts the whole body motions as symbols, generates motion patterns from the symbols, and distinguishes motion patterns based on the symbols. In other words, it is a functional realization of the mirror neurons and the mimesis theory.

2. Mimesis models: symbol emergence by motion recognition and generation

We propose an imitation framework based on the bidirectional computation of motion recognition and generation as shown in Fig.1 We call the framework as "mimesis models".

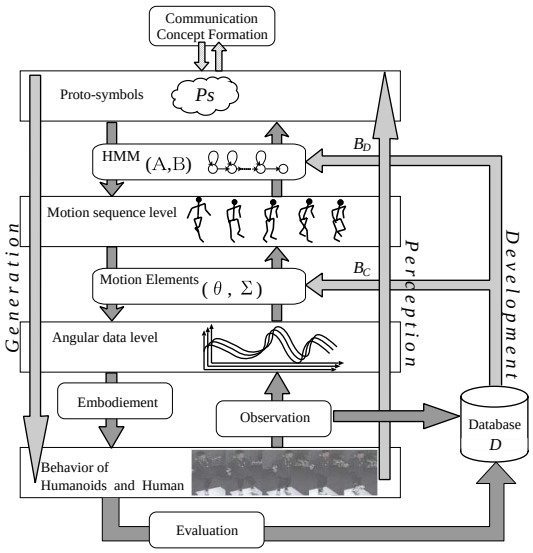

Figure 1: A proposed mirror neuron model

The mimesis models abstract symbol representations from motion observation, generate original motion from the symbols. For the abstraction and generation, some motion elements are needed which correspond to basic pieces of motion. The models have another function that appropriate motion elements for its own body are acquired during motion observation and generation.

We confirmed the feasibility of the mimesis model for real humanoids through experiences. The full paper contains the experimental result and discussion.

References

[1] V. Gallese and A. Goldman. Mirror neurons and the simulation theory of mind-reading. Trends in Cognitive Sciences, Vol. 2, No. 12, pp. 493–501, 1998.

[2] Merlin Donald. Origins of the Modern Mind. Harvard University Press, Cambridge, 1991.