【Grant-in-Aid for Specially Promoted Research】

Science and Engineering (Engineering)

Title of Project： Constructive Developmental Science based on understanding the process from neuro-dynamics to social interaction

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Research Area：Comprehensive fields
Keyword：large scale simulation of brain – body development, Biomimetic robots, Psychological experiment

【Purpose and Background of the Research】

How the microscopic neural activity is reflected in the human behaviors is a big mystery which is not limited to one specific field. However, we seem to understand the mechanism from each classical research field: Medical science and neuroscience have tried to explain the microscopic structure inside a person but have not much focused on the macroscopic structure of social interaction. Contrarily, cognitive science and developmental psychology mainly start from observing human behaviors and therefore it is difficult to approach the internal mechanism.

We have been advocating Cognitive Developmental Robotics (CDR), which aims to provide new understanding of how human's higher cognitive functions develop by means of a synthetic approach that developmentally constructs cognitive functions.

We attack to "understand and model the developmental process of self/other concepts" based on CDR and expect to obtain a new understanding of this process, how the concept is acquired from the state of non-differentiation to one of separation, such as the concept of social relationships based on a computational model of neuro-dynamics.
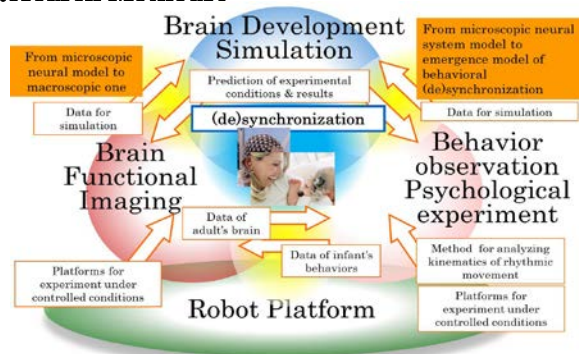
【Research Methods】

Figure 1　Cooperation structure

(1) Simulation group constructs a brain neuro-dynamics model which can exhibit the brain waves and tunes it to compare the activity to the real one, which is observed by MEG or fMRI. (2) Imaging group observes brain activities for example in the social interaction, applying the simulation results. Mirror neuron system is one of the main targets to understand the brain mechanism related to the development of self/other concept. (3) Robot group creates infant robots, which are connected to artificial brain and can interact with a human. (4) Psychological group observes and analyses infant behaviors such as rhythmic movement and social interactions related to synchronization or de-synchronization.

【Expected Research Achievements and Scientific Significance】

First, we may make an impact on neuroscience by suggesting a neural network related to the development of the self-other concept. We may make another impact on cognitive science and developmental psychology by providing simulations or psychological experiments with a robot that have a computational model of the development of the self-other concept. As a matter of fact, also this makes a big impact upon the design theory of robots which are expected into our human society. The mutual feedback with these disciplines is indispensable to improve our model, and the strong connection with them will enable the establishment of a new science, that has a stronger impact on current science and technology.

【Publications Relevant to the Project】

Minoru Asada et al., "Cognitive developmental robotics: a survey" IEEE Transactions on Autonomous Mental Development, Vol.1, No.1, pp. 12--34, 2009.

【Term of Project】 FY2012-2016

【Budget Allocation】 382, 000 Thousand Yen

【Homepage Address and Other Contact Information】

http://www.er.ams.eng.osaka-u.ac.jp/asadalab/project.html