【Grant-in-Aid for Scientific Research on Innovative Areas (Research in a proposed research area)】
Interdisciplinary Area

Title of Project : Understanding brain plasticity on body representations to promote their adaptive functions

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【Purpose of the Research Project】

As the Japanese society ages rapidly, we are experiencing a sharp increase in the number of patients of motor paralysis and other dysfunctions resulting from motor dysfunction, stroke, and neurodegenerative diseases. Thus, establishing effective rehabilitation techniques to overcome these motor dysfunctions is of paramount importance. The key to achieving this is to elucidate the mechanisms by which the brain adapts to changes in body functions. However, abnormalities in somatognosia can occur even in diseases that do not cause motor dysfunction. This indicates that we create and maintain a model of the body in the brain (body representation in the brain).

The purpose of this study is to elucidate the neural mechanisms of the body representation in the brain and the mechanism of the long-term changes in this representation and to apply these findings to rehabilitation interventions. In order to do this, we will attempt to combine brain science and rehabilitation medicine by using systems engineering (Fig. 1). We thereby intend to gain an integrated understanding of motor control and somatognosia in order to create a new academic discipline that is known as *embodied-brain systems science*.

【Content of the Research Project】

In order to achieve the above-mentioned goals of this study, we will establish nine research items (A01-03, B01-03, C01-03). In research items A01/02, we will conduct experiments on humans and monkeys by using methods that are based on interventional neuroscience in an attempt to understand the neural mechanisms of the body representation in the brain and the process by which it changes with respect to somatognosia (sense of agency, sense of ownership) and motor control (muscle synergy control, anticipatory postural control). We will use neural decoding and virus vector technology to investigate markers that reflect changes in the body representation in the brain. In research items B01/B02, we will create dynamic models of the differing time constants of the fast dynamics and slow dynamics of the body representation in the brain based on neurophysiological experimental data and clinical data from patients undergoing rehabilitation. In research items C01/C02, we will attempt to quantify the rehabilitative effects with the markers. By integrating this with a model of the body representation in the brain, we will implement model-based rehabilitation and create predictions of prognosis for intervention. The research items A03, B03, and C03 are those for subscribed research groups.

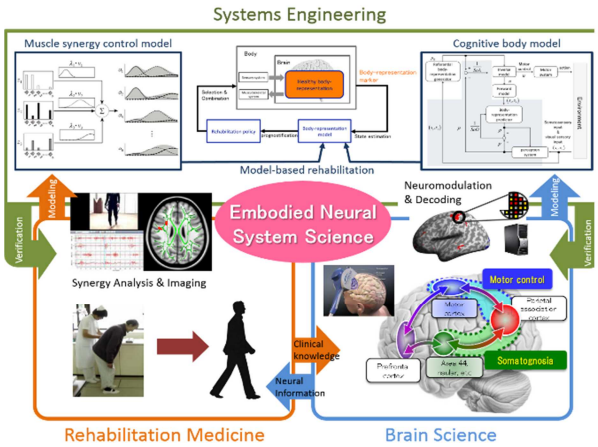

Fig. 1 Embodied-brain systems science area

【Expected Research Achievements and Scientific Significance】

Organically combining brain science and rehabilitation medicine by using systems engineering can be anticipated to yield the following three results:

1. By identifying the markers that reflect the moment-to-moment status and long-term changes in body representation in the brain, which govern somatognosia and motor control, it will be possible to quantitatively evaluate the effects of rehabilitation intervention.
2. By elucidating the slow dynamics of body representation in the brain and developing techniques that can be used to intervene in those dynamics, we will work toward developing innovative model-based rehabilitative techniques that permit predictions of prognosis.
3. We will describe the mechanisms of the important brain functions that are essential to the existence of somatognosia and motor control and pursue the computational principles of the brain that are shared by these functions.

【Key Words】

Body representation in the brain: Internal representation of the body. Indicators of posture and body structure that are updated moment-to-moment by a wide range of sensory inputs that are related to motor performance.

【Term of Project】 FY2014-2018
【Budget Allocation】 1,059,400 Thousand Yen

【Homepage Address and Other Contact Information】

http://embodied-brain.jp