The Chinese University of Hong Kong
Department of Biomedical Engineering

Graduate Seminar – PhD Oral Defence

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Date : 28 June 2022
Time : 9:30 a.m.
Zoom Link : https://us04web.zoom.us/j/9864291516?pwd=vELsi7iEbjh5-mXhBo3V-XWxfwcMGP.1
Meeting ID : 986 429 1516
Password : 888

Title: Rewriting the Lesioned Brain Using BCI-Guided Training Therapy and Transcranial Electrical Stimulation in Chronic Stroke

Stroke is a leading cause of disability, and the demand for stroke rehabilitation is increasing. The existence of neuroplasticity makes it possible for various rehabilitation methods, even for stroke subjects in the chronic stage. Physical training therapies assisted with robotic exoskeleton could induce functional reorganization in the brain. Besides, studies have also focused on non-invasive brain stimulation, including transcranial direct current stimulation (tDCS) and transcranial alternating current stimulation (tACS), which could potentially enhance the neuroplasticity in stroke subjects. This thesis utilized neuroimaging techniques to investigate the functional reorganization and neuroplasticity modulation induced by brain-computer interface (BCI)-guided robot hand training as well as non-invasive brain stimulation interventions.

Unlike other established rehabilitation strategies requiring residual motor function, BCI has been developed to translate brain activity into control signals of corresponding external execution devices such as robots, orthoses, and functional electrical stimulation. The underlying neurophysiological mechanisms induced by the BCI-based training for chronic stroke have not been thoroughly investigated. Functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) are powerful tools to understand the effects of BCI on neuroplasticity better. TACS could directly interfere with cortical rhythms. Although the neurophysiological mechanisms of tACS are still not thoroughly understood. It is believed that the frequency-specific entrainment effects play an essential role in modulating endogenous brain oscillations. In this thesis, concurrent tACS and fMRI were collected for chronic stroke individuals. TDCS has been shown to facilitate post-stroke motor rehabilitation. However, the functional modulation effect of anodal tDCS is not thoroughly studied, and the heterogeneous lesion profiles of stroke individuals would further complicate the stimulation outcomes. This thesis aimed to investigate the functional changes in sensorimotor areas induced by anodal tDCS and explore whether the individual electric field strength would affect the functional outcomes.

In summary, this thesis expands the understanding of neural modulation responding to external interventions applied to chronic stroke patients. It shed light on the mechanism of neural response to external interventions, which could help develop more effective rehabilitation protocols for stroke patients in the future.

***** ALL ARE WELCOME *****

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