Comparison of Three Modalities of SMR-BCI within Stroke Patients

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Introduction: Sensorimotor rhythm based brain-computer interface (SMR-BCI) has been widely used for stroke rehabilitation. Stroke patients with motor dysfunction could consciously move the paralyzed hand with BCI, which is demonstrated to be beneficial to the rehabilitation of lost motor function[1]. However, discrimination performance of BCI has large effects on the rehabilitation efficacy. To solve the problem, investigators have already proposed many different modalities of mental tasks for BCI control, in which movement intention[2], motor imagery[3] and selective sensation[4] are most widely studied. Here, we aim to compare the BCI performance of these three mental tasks in stroke patients, and find out which is the best for rehabilitation.

Material, Methods and Results: Six stroke patients were recruited in this research, and all of them had motor disability with right side of body due to lesions on left hemisphere. Each of the patients were assigned to perform three blocks of different mental tasks, including movement intention, motor imagery and selective sensation. Each block contains 30 trials for both left and right hand tasks. Timeline of one single trial was shown in Fig.1(1). In this abstract, we only analysis the performance of paralyzed hand (right hand), and EEG signal features from right hand tasks would be discriminated from idle mode. The decoding results were shown in Fig.1(2). T-test indicates movement intention has better performance than other two modalities with $p<0.05$.
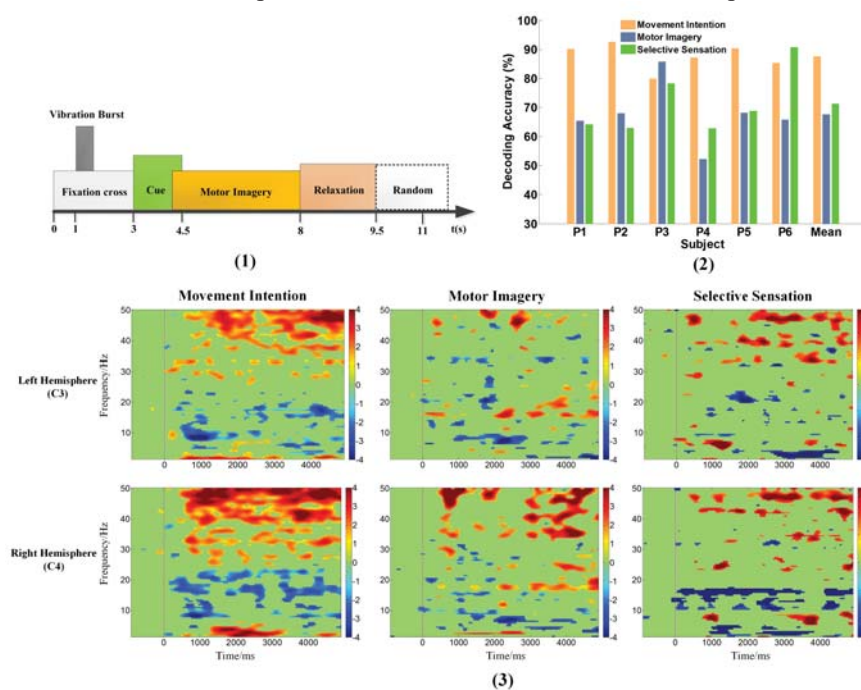

Figure 1. *(1)Timeline of single trial in this experiment. (2)Decoding accuracy of 3 different mental tasks. (3)Motor cortical activations on both left (C3) and right (C4) hemispheres druing different tasks.*

Discussion: For stroke patients, movement intention maybe more similar with real movement, and has more activations in alpha and beta bands than motor imagery and selective sensation, which makes it has the highest decoding accuracy. As indicated in Fig.1(3), gamma band was also significantly activated during mental task of paralyzed hand, which was not found in healthy subject's studies.

Significance: This work has compared three different modalities of SMR-BCI, and demonstrated movement intention to be the best choice as mental task for stroke patients.

References

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