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Should frequency band selection algorithms include neurophysiological constraints?

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Introduction: In order to build a reliable BCI, it is useful to calibrate the BCI system considering the characteristics of each user's ElectroEncephaloGraphy (EEG) [1]. A concrete approach is to select user-specific frequency bands based on data. Our previous work suggested a correlation between online BCI performances and the selected user-specific frequency bands [2]. In particular, users with the highest performance were the ones for whom the selected frequency bands' width was larger than 3.5Hz, and selected frequency band mean belonged to α-lowβ (5-16 Hz). However, it did not reveal whether the selected user-specific frequency band in α-lowβ causes higher performance or if users with higher performance have their user-specific frequency bands in α-lowβ range. In this study, we developed a frequency band selection algorithm to select user-specific frequency bands only from α-lowβ range and investigated how the online BCI performance change [3].

Methods and Results: We conducted a Motor Imagery (MI) BCI experiment with the same protocol as our previous work [4] with 12 healthy users who performed left or right hand MI. Their user-specific frequency bands were selected restrictively between 5-20 Hz and the minimum width was set as 3.5Hz. Then the average online BCI accuracies were compared with control users who have selected user-specific frequency band between 8-30Hz and without restriction for width from our previous study in [4]. The comparison results showed no significant difference ($p=0.26$) in online BCI performance. We will still continue this investigation with several users but this current result may suggest the users with higher performance can modulate their α-lowβ range activity well and their user-specific frequency bands belong to α-lowβ range as a result.

References

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