
Proposition of an optimization of the selection of a discriminative frequency algorithm for Motor-Imagery based BCI

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Abstract

In Motor-Imagery based Brain-Computer Interfaces (MI-BCIs), MI tasks modulate EEG activity in the α and β frequency bands (8-30 Hz). Data driven methods are often used to select features in those bands during the system calibration, with little consideration for the resulting human performances. In a previous study [1], our analyses revealed that (1) Subjects with a Most Discriminant Frequency Band - MDFB width lower than 3.5 Hz have more difficulties controlling a MI-BCI compared to subject with a larger MDFB width (*Wilcoxon test: $s=-4.4, p< 10^{-5}$*); (2) Subjects with a MDFB mean value above 16 Hz seem to have lower performances than subjects with a MDFB Mean value under 16 Hz (*Wilcoxon test: $s=2.6, p< .05$*).

Based on those results we modified the frequency band selection algorithm from [2 - Algorithm 1] by adding constraints on the band to be selected. We imposed a MDFB width larger than 3.5Hz and a MDFB mean value under 16Hz. For the first part, we smoothed, for each channel c , the $\text{score}_c(f)$ signal (see Algorithm 1[2]) , which represents the correlation, at each frequency, between the band power of each trial and its label.

This step allowed us to avoid having a MDFB width of 0.5. Then, if the MDFB width was still below 3.5Hz, we increased the band on the side where the correlation value was the highest until reaching the desired width. For the second part, we constrain the frequency with the highest score of correlation to be between 8 and 16Hz and we used the algorithm for frequencies between 5 and 20 Hz only. We are testing this new algorithm in an experiment [3] to see if adding constraints could increase users’ performances.

Benaroch, et. al, (2020) BCI meeting (submitted)

Blankertz et. al (2007) IEEE sig. proc

Yamamoto S., (2020) Cortico (submitted)

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