

Dataset IIIa: 4-class EEG data

Group Information:

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Processing Techniques:

- 1) Apply surface Laplacian to the raw EEG signals of the three subjects to improve spatial details.
- 2) Filter the re-referenced signals in an 8-30 Hz band with a causal linear IIR band-pass filter, in order to obtain ERD (Event-Related Desynchronization) signals.
- 3) Use OVR (One-Versus-the-Rest) algorithm [1], which is an extension of CSP (Common Spatial Patterns) algorithm to multi-class case, to extract features related to the four tasks.
- 4) Combine support vector machine, k-nearest neighbor classifier, and a normal densities based linear classifier to classify [2]. For different time points, different classifiers are adopted to obtain continuous classification outputs.
- 5) Use a technique named bagging [3] to get the final results.

Data Format:

We have down-sampled the continuous classification outputs for the three subjects from the original sampling rate of 250 Hz to 10 Hz. Consequently, there are 70 outputs for each class in a single trial and 2 outputs for each class in each 0.2s-segment.

Results for the three subjects are saved in three Matlab-format files, respectively:

Tsinghua_k3b.mat, **Tsinghua_l1b.mat**, and **Tsinghua_k6b.mat**.

Each file contains the following variables:

tsd: continuous classification outputs for the whole dataset. Its size is $\mathbf{N} \times \mathbf{M}$, where \mathbf{N} is the total number of time points for all trials and \mathbf{M} is the number of classes. In our case, $\mathbf{M}=4$. For subject k3b, $\mathbf{N}=360 \times 70$; For subject l1b and k6b, $\mathbf{N}=240 \times 70$.

trig: trigger time points for the whole dataset.

Fs: sampling rate. In our case, $\mathbf{Fs}=10$.

These three variables can be evaluated by the function **bci4eval.m** in BIOSIG toolbox:

X=bci4eval(tsd, trig(testset), classlabel(testset), 0, (7*Fs-1), Fs)

References:

- [1] Wei Wu, Xiaorong Gao, and Shangkai Gao, "One-Versus-the-Rest (OVR) algorithm: an extension of Common Spatial Patterns (CSP) algorithm to multi-class case," submitted to *IEEE EMBS Conf.*, Shanghai, China, 2005.
- [2] J. Kittler, M. Hatef, R. Duin, and J. Matas, "On combining classifiers," *IEEE Trans. Pattern Analysis and Machine Intelligence*, vol. 20, pp. 226-239, 1998.
- [3] Richard O. Duda, Peter E. Hart, and David G. Stork, *Pattern Classification*, second ed., John Wiley & Sons, Inc., pp. 475-476, 2001.