BCI-competition IV – Data set I

Algorithm Description

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Preprocessing:

1. Subject specific frequency bands are first selected using particle swarm optimization [1][2].
2. *Time point* of maximum seperablity for training is selected based on minimum squared error in 5-fold cross validation
3. Application of Common Spatial Patterns (CSP) on filtered data.
4. Eigenvector filtration of the selected Eigen vectors of the mapping matrix between 5-20% of the values closer to zero specific to each subject for noise suppression [2]. This threshold is selected based on minimum squared error.

Feature extraction:

1. The CSP filtered data in the surrogate data space is analyzed individually to choose the optimum number of CSP Eigen Vectors for feature extraction. Eigen-vectors ranging from 1 to 4 are selected from each side of the CSP mapping matrix to produce minimum squared error in cross validation.
2. Log of the variance is then computed for the corresponding chosen channels in the surrogate data space which are used as features.

Classification:

1. Linear Discriminant Analysis (LDA) is used to classify at each time point i.e at the rate of sampling interval.
2. Moreover, 1-2.5 seconds moving average filter is applied on the classification output of three subjects which smoothes the continuous output and helps to suppress spikes or outliers (noise by the blinking of eyes or electrical noise). This moving average filter is applied only on Subjects 1c,1d and 1e. Applying this filter on subjects 1a, 1b, 1e and 1f deteriorates the classification performance, probably because these subjects are artificially generated and there are no spikes or prominent outliers.

[1] A. Satti, D. Coyle, G Parasad. Optimal Frequency Band Selection with Particle Swarm Optimization for a Brain Computer Interface. *Proceedings of the Workshop on Evolutionary Computing Lecture Series by pioneers, University of Ulster*. August 18-22, 2008.

[2] A. Satti, D. Coyle, G Parasad. Optimizing Common Spatial Pattern for a Motor Imagery-based BCI by Eigenvector filteration for a BCI. *4th International Brain- Computer Interface Workshop and Training Course 2008 Graz, Austria*. pp. 62-64, Sep 2008.