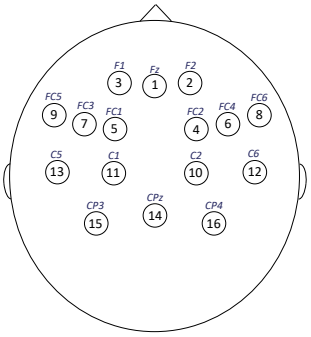
Project Description

Mini Project #2

Classifying Imagined Movement using Common Spatial Pattern (CSP)

Projects should be done individually. You may consult with your colleagues on the projects but you must submit your own work.

Data Collection



Subject training plays an important role in the accuracy of a BCI system. Research has shown that subject performance significantly increases after of couple hours of training. Continuing the experiment from last week, train your subject by recording several more sessions. Make sure to save each run in a different file to be used for the project. Complete the project report as described below.

Introduction

Write a short description of the experimental paradigm.

Stimuli and Procedure

Describe your filtering method, sampling frequency, number of experimental blocks and trials, how you separated the two conditions (imagining left vs right), and how you checked the signal quality.

Notes:

1. Please use eig(A,B) where A and B are matrices left and right respectively as opposed to eig(A,A+B).

2. The output of eig is sorted in ascending order so please use the last 6 eigen values instead of first six.

Results

Training Imagined Movement:

Describe your behavioral results. Do you see improvement across training sessions? Does accuracy improve over time?

Applying Common Spatial Pattern Filters:

Calculate your CSP filters and explain your steps. Choose the first 6 CSP filters corresponding to the largest Eigenvalues. Plot separately the average projected response for the classes (left vs. right) for each of the projected dimensions.

Compare the separability of the two classes before and after CSP filtering. What is the effect of spatial filtering on your data? Display the CSP filters on the scalp. Use the standard deviation of the projected data in each trial to remove the time dimension. Explain the benefit of using standard deviation.

Classification in CSP-Projected Space:

Divide your trials into 90% train data and 10% test data. Use your training set to train a Linear Discriminant Analysis classifier and use the Linear Discriminant Analysis classifier to determine the imagined movement direction for your test set. What percentage of trials are correctly classified? Repeat this operation ten times with different random train-test splits (ensure they do not overlap). Estimate the standard error of your classification (Standard Error = Standard Deviation / sqrt (number of tests)).

References (on Courseworks):

Lecture notes

Blankertz, Benjamin, et al. "Optimizing spatial filters for robust EEG single-trial analysis." *Signal Processing Magazine, IEEE* 25.1 (2008): 41-56.