Exercises sheet #10 (Summer Term 2010)

Acquisition and Analysis of Neuronal Data

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For these exercises please download data set *imagVPaw.mat* (material) from `https://ml01.zrz.tu-berlin.de/wiki/Main/SS10_AnalysisOfNeuronalData`.
During this experiment the subject performed left and right hand motor imagery according to visual cues. The markers define the time points when the visual cues appeared. Motor imagery was performed approximately until 4s after the visual cue.

Exercises

1. **Determining a Frequency Band (3 points)**
   Calculate the classwise averaged power spectrum density at scalp location C4 in the data set *imagVPaw*. For each motor imagery condition, you may use the interval [750 4000] ms. Determine a frequency band that seems useful to discriminate the two motor imagery conditions. Remember what was said in the lecture about spectra and spatial filtering. *(To calculate the average spectra of single trials you can use* `>> h= spectrum.welch; psd(h, X(:), 'Fs',100);` *assuming the single trials to be the columns of* `X` *and sampled at 100 Hz.)*

2. **Common Spatial Pattern Analysis (4 points)**
   Apply a band-pass filter to the given EEG signals according to the findings in exercise 1 (use `band= [11 15]` if you did not succeed) and perform a CSP analysis for the time interval [750 4000] ms. Plot the spatial filters corresponding to the 3 largest and the 3 smallest eigenvalues as scalp maps. Apply the six spatial filters to the band-pass filtered EEG signals. The resulting signals are subsequently called CSP-filtered signals. Implementing CSP as matlab function would be a good idea.

3. **Visualization and Separation of log power Features (3 points)**
   Take the CSP-filtered signals, extract single trials in the time interval [750 4000] ms and calculate the log variance within each trial. This gives a six dimensional feature vector for each single trial. Select two of those six dimensions for visualization (how to choose is up to you: according to the eigenvalues, the scalp maps of CSP filters, or the ERD/ERS curves): Make a scatter plot with the two selected dimensions on the x- resp. y-axis and use two different colors for the two conditions. Calculate the Fisher Discriminant separation in the two dimensional space and plot the separating line into the scatter plot.

Please submit your solutions by email until Wed, June 30th.