Exercises sheet #09 (Summer Term 2010)

Acquisition and Analysis of Neuronal Data

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For these exercises please download material (data set 'erp_hexVPsag') from `https://ml01.zrz.tu-berlin.de/wiki/Main/SS010_AnalysisOfNeuronalData`. All exercises refer to that data set. This data set was recorded using the Matrix Speller paradigm, see BCI lecture #2.

Exercises

1. **Scalp Topographies of ERPs** (3 points)
   Calculate the average potential separately for the classes *target* and *non-target* in the following intervals (msec): [120 140], [200 220], [230 260], [260 290], [300 320], [330 370], [380 430], and [460 490]. (This involves averaging over all trials of the respective class and averaging over all sample points in the respective time interval.) Visualize the result as scalp topographies using the function `scalpmap`, i.e., 8 maps for each class.
   Remark: In order to make the maps look reasonable, a so called 'baseline correction' has to be performed: for each channel, calculate the average across the time interval [-100 0] msec and across all trials; this results in one value for each channel; subtract this 'baseline' from each map (see above) and plot this difference.

2. **Visualization with the Biserial Correlation Coefficient** (4 points)
   Implement a function for the calculation of the signed r^2-value (see biserial correlation in the first lecture). From the given data set, extract epochs for the time interval $[-100\ 600]$ msec relativ to each stimulus. Calculated for each channel and each point in time the signed r^2-value and visualize this (channel$\times$time points) matrix using `imagesc`. Average the signed r^2-values within each of the intervals given in exercise 1 and visualize the result (for each interval) as a scalp topography. (This method can be used to select the intervals of interest.)

3. **Bias in Empirical Covariance Matrices** (3 points)
   Generate 100 samples from a 200-dimensional Gaussian distribution. The standard deviation of the 200 dimensions should be logarithmically equally spaced between 10 and 1000 (using functions `logspace` and `randn`). Calculate the empirial covariance matrix from the generated data (using function `cov`). Plot the Eigenvalue spectrum of the true covariance matrix and of the empirical covariance matrix into one figure. You should observe the bias that was discussed in the lecture.

Please submit your solutions by email until Wed, June 23th.