BCI-competition 2003 - the Graz data set
Model Description

Christin Schäfer
Fraunhofer FIRST Institut
Kekuléstr.7, 12489 Berlin, Germany
christin.schaefer@first.fraunhofer.de

Steven Lemm
Universitätsklinikum Benjamin Franklin
Hindenburgdamm 30, 12200 Berlin, Germany
steven.lemm@first.fraunhofer.de

30.04.2003

Preprocessing

From the neurophysiological perspective imaginary hand movement leads to a suppression of the μ-rhythm, Event Related Desynchronization (ERD) at 10Hz and 20Hz over the motor-cortex (C3 and C4). Consequently, we focus only on the channels C3 and C4. (Cz is excluded.) The data are narrow-bandpass filtered using Morlet-Wavelets at the lower and higher frequency μ-rhythm, in that specific case centered at 10Hz and 22Hz, respectively. To match the requirements of processing the data online, all filter were chosen to be causal.

Model

The preprocessed training data were used to estimate at every time instance t_i, $i = 1, \ldots, 1152$, a multivariate normal distribution for each class (left/right) in a robust manner.

Further more for every time instance, we obtained an upper bound for the Bayes error of the two probability models. Using this, we calculate a weighting by $w(t) = 0.5 - \text{Bayes error}(t)$.

For online classification at time instance T the decision is based on all previous time instances $t \leq T$ using the expectation of the weighted probabilities:

$$p_t(\text{left}|x) = \frac{P_t(x_t|\text{left})}{P_t(x_t|\text{left}) + P_t(x_t|\text{right})},$$

$$D_T(\text{left}|x_1, \ldots, x_T) = \frac{\sum_{t \leq T} w(t) p_t(\text{left}|x_t)}{\sum_{t \leq T} w(t)}.$$

To match the convention that negative (positive) values indicate left (right) trials, we transform the result: $\tilde{D}_T = 0.5 - D_T$, where the magnitude reflects the confidence we assign to the actual decision.