EVENT-RELATED DESYNCHRONIZATION-BASED VERSUS BEREITSCHAFTSPOTENTIAL-BASED CLASSFIERS IN STROKE PATIENTS

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AIM: To compare the most well-known volitional movement-related electrophysiological phenomena for upper-limb movements in stroke patients, as source of movement classifiers.
METHODS: Six stroke patients (2 women, age 60.17±9.49, Fugl Meyer 85.5±30.05) were recruited for the experiment. The subjects were asked to perform consecutive, self-initiated reaching movements with the affected upper limb. The movements were distributed across two sessions of 30 trials each, with a resting break of 5 minutes between them. EEG was recorded using a g-tec 65 electrode g.EEGcap and a g.USBamp amplifier at 256Hz. Signal was recorded from 32 parietal, centroparietal, frontocentral and frontal channels symmetrically distributed. Data from EMG and gyroscopic sensors placed on the limb were used to detect movement events. For the BP classifier, EEG signal was filtered using a band filter [0.05Hz-1Hz]. Among C_1, C_z and C_2 channels, the average potential of the training trials, in the target time window [-1.5s, movement onset], with the most pronounced decay was selected as the model pattern. For the ERD classifier, the ten pairs (channel, 2Hz frequency band) with the most pronounced frequency decay in the same target window with respect to base level window [-3,5s, 1.5s] were selected as input to a Naïve Bayes classifier. The classifiers were independently built and tested by leave-one-out cross validation.
RESULTS: Figure 1 presents the results obtained. On the one hand, the classifier using BP features performs better than the ERD-based classifier for four out of the six patients. Average percentages of good trials (GT), i.e. trials with movement correctly identified and no false positives, are 53.1% (± 24.2) and 53.8% (± 26.0) for the BP-based and the ERD-based classifiers, respectively. Average true positive (TP) rates reach 71.0% (± 16.0) and 73.1% (± 22.0), respectively. On the other hand, the latency of the correctly identified movements is closer to the movement onset for the BP-based classifier (+136 ms, ±16), presenting the ERD-based classifier an average longer delay (+394 ms, ±350).
CONCLUSION: Online detection of volitional movements has become a complex problem for BCI-based real-time rehabilitation. EEG phenomena related to movement preparation, such as BP and ERD, has shown to be arbitrarily absent or distorted in healthy subjects. The present work has revealed certain features of these phenomena that seem to be also dependent on the patient but complementary. Therefore, an intelligent combination of the both could lead to a more homogeneous solution.

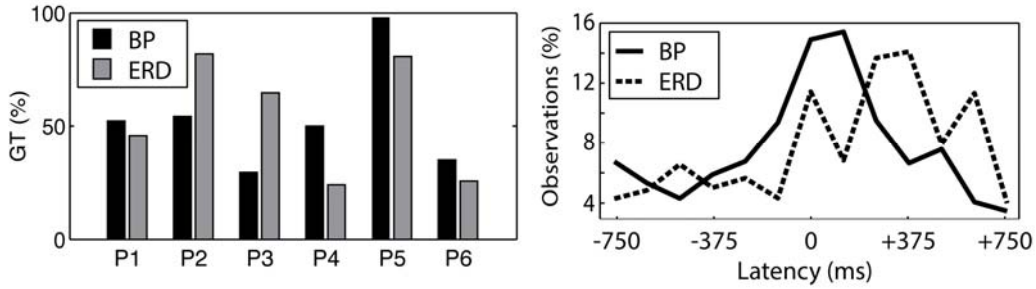

Figure 1: Left: percentage of good trials (GT), i.e. trials with movements correctly identified and no false positives, for the six patients using BP and ERD features. Right: distribution of the latency (0 ms = movement onset), of the movements correctly identified using BP and ERD features.