First contact screening of a BCI Pilot

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Introduction

Mental tasks like motor imagery induce changes in the electroencephalogram (EEG) which can be detected and translated into commands for several applications by a brain-computer interface (BCI). However, BCI use is challenging and BCIs do not work satisfactory for everybody. To find the pilot of the GRAZ-BCI Racing Team MIRAGE 91, we checked the BCI aptitude of a candidate. Here we show how to perform a first contact sreening using a small EEG setup to facilitate a go/no go decision about the BCI capabilities of our prospective pilot. We share our experience and present the first contact screening results of our candidate.

Methods

The system was based on the Graz-BCI [1].
Pilot: 36 year old male, suffering from severe motor impairment due to a brainstem stroke in 01/2014.
Paradigm: The paradim was based on the Graz-BCI paradigm as seen in figure 1 [2].
Setup: EEG was acquired using 16 active Ag/AgCl electrodes which were positioned in an equidistant manner over sensorimotor areas around C3, Cz and C4 electrode positions.
Data: We recorded 50 trials per class of motor imagery (MI) of left hand, right hand and feet. In addition we performed a second session where we recorded MI of right hand, feet and a rest-condition.
Analysis: The data was filtered between 6 Hz and 35 Hz and artefact-contaminated trials were excluded. In a cross validation loop (10 times 5 fold), common spatial pattern (CSP) filters were trained (one versus one class). We calculated 12 logarithmic bandpower features and trained a shrinkage regularized linear discriminant analysis (sLDA) with features located 2.5 seconds after the cue.

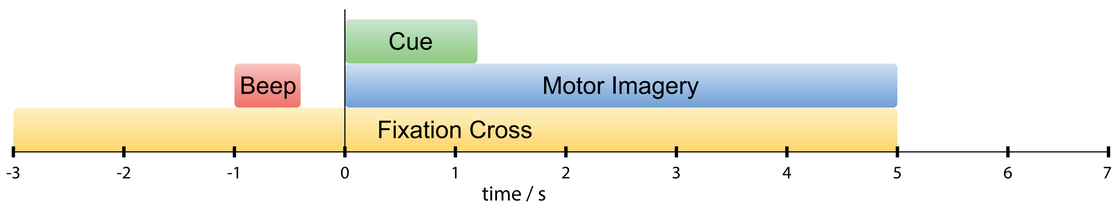

Figure 1: Construction of paradigm over trial time with reference period from -2 to -1 seconds, the cue at zero and from then on MI.

Results

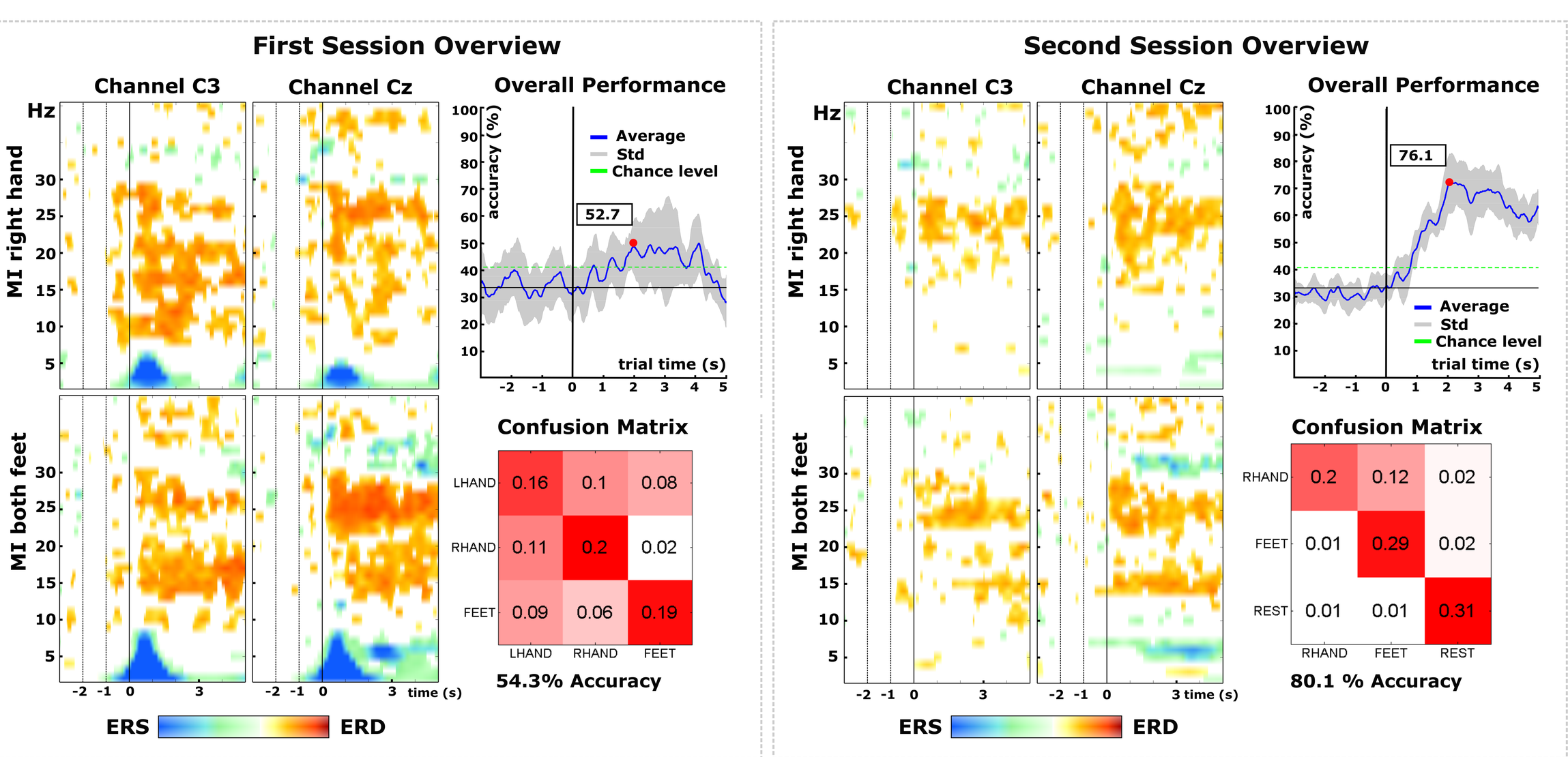

Figure 2: Session screening results: ERD/ERS maps calculated for each session for right hand and both feet ME. Overall performance shows cross-validation accuracy over trial time. Confusion matrices show results for second 1 to 5 of the trial [3].

Discussion

We successfully performed a BCI screening in two sessions. The results in Figure 2 show higher accuracies in session 2 (76.1% vs 52.7%). We credit the differences between the two sessions to agitation and the novelty of BCI technology to the user in the first session. In conclusion, a second screening session can be beneficial and a prospective pilot should not be disregarded after one session.

References

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Acknowledgments