First contact screening of a BCI Pilot

M.K. Höller[1]*, A. Schwarz[1], D. Steyrl[1], K. Statthaler[1], G.R. Müller-Putz[1]

[1] Institute of Neural Engineering, BCI-Lab, Graz University of Technology
E-mail: gernot.mueller@tugraz.at.

Abstract

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 MIRAGE91, we checked the BCI aptitude of a candidate. We share our experience and present the first contact screening results of our candidate. The Pilot is a 31 year old man, suffering from severe motor impairment due to a brainstem stroke in 2014. For EEG recording we used 16 active Ag/AgCl electrodes which were positioned in an equidistant manner over sensorimotor areas around C3, Cz and C4 electrode positions. Using the paradigm described in [1], 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. For analysis, 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 patterns (CSP) filters were trained in a one versus one class method. We calculated 12 logarithmic bandpower features (first and last two projections of each CSP model) and trained a shrinkage regularized linear discriminant analysis with features located 2.5 seconds after the cue.

We successfully performed BCI screening in two sessions. The results in Figure 1 show higher accuracies in session 2 (70% vs 45%). In conclusion, a second screening session can be beneficial and a prospective pilot should not be disregarded after one session. We credit the differences to agitation and the novelty of BCI technology to the user in the first session.
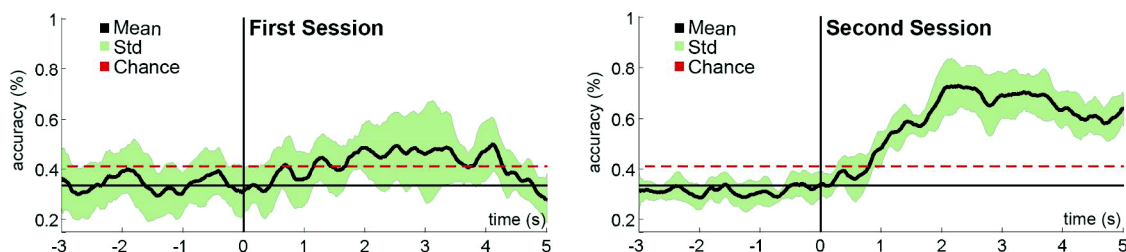
Figure 1: Average session performance overview of three classes (session 1: left hand, right hand, feet; session 2: rest, right hand, feet)

References

[1] G. Pfurtscheller and C. Neuper, "Motor imagery and direct braincomputer communication," Proceedings of the IEEE, vol. 89, pp. 1123–1134, 2001.

Short Biography

Maria K. Höller is studying Biomedical Engineering at Graz University of Technology. This abstract shows a brief insight on her bachelor thesis, which is done within the GRAZ-BCI racing team. For her masters, she plans to extend her experiences towards Brain-Computer interfaces and to focus on Neural Engineering.