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Detecting walking intention using EEG phase patterns

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Introduction: One use of EEG-based brain computer interfaces (BCIs) in rehabilitation is the detection of walking intention [1]. So far neural correlates of movement intention based on amplitude [2, 3] or power [3] have shown promising results for session-specific evaluation. However, since EEG signals present an inherent variability among sessions, BCIs need to be recalibrated before every usage. Recalibration is a time-consuming and tiring process especially in repetitive therapy sessions. Thus, it would be beneficial to remove the need for session-specific BCI recalibration. In this abstract we propose a novel feature based on the movement related cortical potential (MRCP) phase patterns that contributes to a successful detection of movement intention in transfer cases, without BCI recalibration.

Material, Methods and Results: We demonstrate the utility of MRCP phase patterns in a pre-recorded dataset [2], in which 10 healthy subjects executed a self-initiated gait task in three sessions. MRCP amplitude signals were decomposed using Hilbert transform into phase and power components. The effect sizes of the three features in channel Cz relative to the baseline (shaded interval) are presented in Fig. 1A. Next, BCI detectors of gait intention based on phase, amplitude, and their combination, were evaluated in two conditions: intrasession usage (session specific calibration) and intersession transfer, with results shown in Fig. 1B.

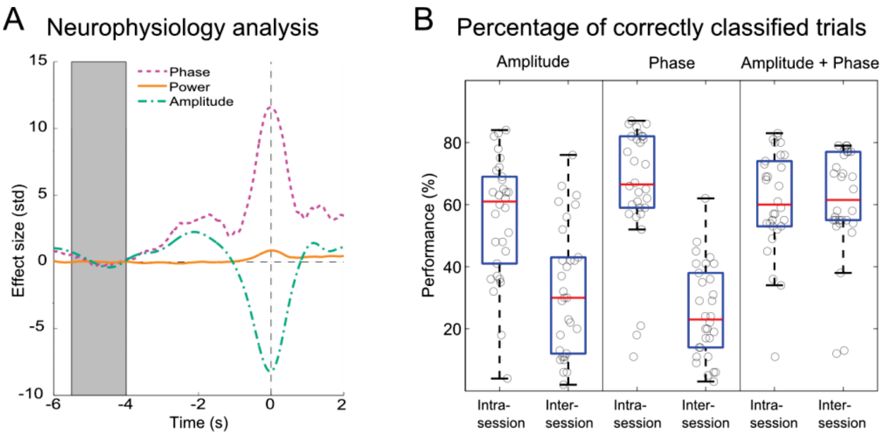

Figure 1. *A. The neurophysiology analysis of the three types of features: phase, power and amplitude. B. The detection performance during intra- and intersession evaluations using three detection models (amplitude based, phase phase and combined amplitude and phase based).*

Discussion: The neurophysiology analysis in Fig. 1A shows that the phase features have higher signal-to-noise ratio than the other features. Results have shown that the phase based detector is the most accurate for session specific calibration. However, in intersession transfer, the detector that combines amplitude and phase features is the most accurate one and the only that retains its accuracy relative to the intrasession condition. Thus, MRCP phase features improve the detection of gait intention and could be used in practice to remove time-consuming BCI recalibration.

Significance: This abstract introduces MRCP phase patterns as novel features for the detection of movement intention. By combining MRCP amplitude and phase information, we attained a detector with a more robust performance between sessions, outperforming the detectors that use only one type of information.

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