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Increased spatial resolution reveals separated EEG activation of individual finger movements

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Introduction: The exploration of high EEG electrode densities is of great interest in current BCI research. Therefore, we investigate the neural representations of single-finger movements using high-density EEG.
Methods: The system used in this work is based on flexible electrode grids with an electrode diameter of 5.9 mm and a distance of 8.6 mm between electrode centres [1]. In two healthy subjects, 73 out of 256 electrodes were placed over the sensorimotor cortex contralateral to the hand side of the finger movements. Additionally, nine standard EEG sensors were placed over the same area according to the 10-20 system. All subjects performed voluntary movements of individual fingers. Event-related desynchronization/synchronization (ERD/S) was calculated to produce high-density and 10-20 topography plots [2]. The beta (13-30 Hz) band was used for feature extraction from the EEG. A Wilcoxon signed rank test was used to find significant movement related beta band changes. Fig. 1 shows the topographies, representing superimposed finger activity on the MNI head.

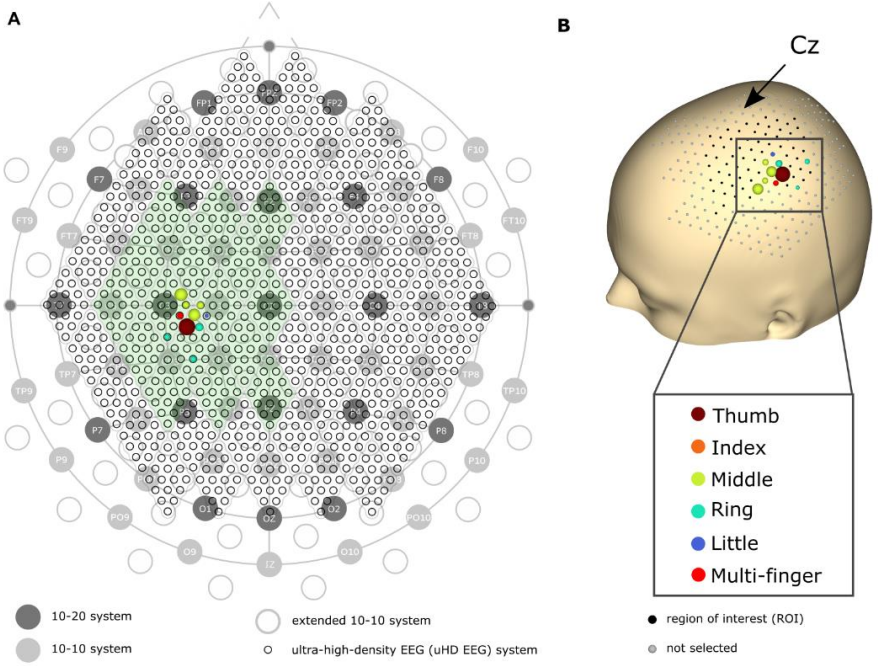

Fig 1: A focal point overlying the sensorimotor cortex around the 10-20 position C3 shows the highest activation. Ten electrodes were color-coded according to the finger with the greatest significance in ERD/S change, one finger includes information from several fingers (Mult-finger).

Results: High-density / 10-20 beta power revealed 11% / 11% single-finger, 1% / 61% multi-finger and 88% / 28% no-finger sites, respectively. Hence, high-density EEG provides more distinguishable features for single finger movement decoding on a smaller area compared to 10-20 EEG recording.

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