OBJECTIVE
The development of a miniaturized, portable NIRS system, to be integrated with EEG for BCI applications. Here, we present our most recent step toward this goal, a table-top multi-channel NIRS imager utilizing direct LED illumination and digital signal processing.

INTRODUCTION
Principles of Near Infrared Spectroscopy (NIRS):
• Sensitive to absorption changes caused by hemodynamics:
• Uses low-energy optical radiation (~700-900 nm)
• One optode pair (transmitter (source) + receiver (detector))

Principles of near-infrared spectroscopy (NIRS):
• Fiber optic bundles, sometimes integrated electronic sensors
• Recent step toward this goal, a table-top multi-channel NIRS imager integrated with EEG for BCI applications. Here, we present our most

Instruments and Design:
• Ultracompact, EEG-compatible NIRS System
• Molar extinction coeff. [cm⁻¹]更改

RESULTS
• Averaging over 100 samples reduces noise by factor 10

Experimental Results
EEG
• No spectral interferences from LED optode
• Sustained μ-decays (α- & β-range) during contralateral tap

NIRS
• Prototypical activation for motor task observed: HB0+ & HBR-; sustained response to tapping
• HB0: Susceptible to physiological noise, therefore less indicative for tapping side
• HBR: Stronger decrease contralateral to tapping side
• Robust, condition related single-trial response

DISCUSSION
• No interferences in EEG signals
• Excellent signal-to-noise ratio in HB0 and HBR
• Fast and flexible probe placement for concurrent EEG/NIRS measurement
• Robustness of single trial response promising for real-time applications (BCI, neurofeedback)
• Portability/compactness allows field studies

REFERENCES
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Simultaneous NIRS-EEG validation
Paradigm:
• Alternating self-paced, visually cued finger tapping
       • Left (20 s) → rest (20 s) → right (20 s) → rest (20 s) → 9 times
• NIRS measurement:
  • 2 Sources, 4 Detectors (per hemisphere: 1 x 2 D), fsweep = 22.5 Hz
  • Customized EEG cap (EASYCAP® for electrode/optode placement (Fig. S))
• Signal analysis in MATLAB® based NLAB (Charité Berlin): Band pass filter, modified Beer-Lambert law, block-averaging
• EEG measurement:
  • 12-channel recording with BrainAmpt (Brain Products GmbH): fsweep = 1.0 kHz, F2G as reference, BW = DC to 250 Hz
  • Band pass filter (0.5 Hz, 100 Hz), epoched for each condition (±2 s to +2 s relative to stimulus onset)
  • Wavelet based time-frequency (TF) analysis (Morkel, 12 cycles, 5-25 Hz) on single trial basis
• Averaging of single trial TF results; baseline (-1 to 0 s) subtraction