Shedding light on motor-independent communication

Shedding Light on Motor-Independent Communication:
fNIRS-based Brain-Computer Interfacing for Everyday Life

Patients with locked-in syndrome are almost completely paralyzed while at the same time being fully awake and aware. These fully conscious humans are in need of motor-independent communication. A brain-computer interface (BCI) circumvents normal output pathways through use of voluntarily evoked brain signals. A BCI thus translates brain activation into intended meaning. In this thesis, functional near-infrared spectroscopy (fNIRS) is used to measure hemodynamic brain signal changes in the context of a BCI. The three studies in this thesis aimed to develop and validate straightforward, robust, efficient and cost-effective communication paradigms that can be tailored to individual users and eventually be used in daily life. In **chapter 2,** a binary fNIRS-BCI was tested with mental drawing for "yes" and resting for "no". In **chapter 3**, a binary fNIRS-BCI with spatiotemporal encoding was tested, *i.e.*, unique imagery tasks and time windows for each answer option. In both studies, roughly half of the participants were able to communicate using the binary fNIRS-BCI. In **chapter 4**, participants used a four-choice BCI with a single mental task. All six participants could communicate using the fNIRS-BCI via three sensory modalities (visual, auditory and tactile) across three consecutive days. Two participants even communicated using the fNIRS-BCI in a cafeteria. The results in all three chapters show that fNIRS-BCIs are promising and worth further development and investigation in clinical contexts.