Where to go next? ALS Patients Control a Virtual Wheelchair using a Tactile Brain-Computer Interface

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Brain-Computer Interfaces (BCI) are based on brain activity and thus allow for communication and interaction with the environment for people with loss of motor function. BCIs can be used to assist the severely disabled, e.g. patients suffering from amyotrophic lateral sclerosis (ALS, a neurodegenerative disease leading to paralysis).

Many BCIs, however, rely on intact vision and gaze control to work efficiently, and these preconditions are often not met in later stages of ALS. Because of this limitation, alternative BCIs that instead use auditory and tactile channels are in the focus of recent research.

We report a longitudinal study of a tactile BCI based on event-related potentials (ERP). Since this paradigm is designed for wheelchair control, four directional commands are selectable by concentrating on short vibrations (applied by small, computer-controlled devices) on body positions corresponding with the desired movement directions. Doing so elicits a P300 ERPs that can be measured with electroencephalography and detected using machine learning.

Twelve ALS patients were invited to three sessions with three months in between, to assess the feasibility of the BCI with potential end-users and the impact of both training and disease progression on ERPs and BCI efficiencies. Patients started out with a simple oddball paradigm. We then proceeded with several calibration runs to define classifier weights, a guided BCI task with feedback of the classification, and a semi-free wheelchair navigation task within a virtual 3D apartment.

In this poster, we describe first results from two ALS patients based on their respective first sessions.