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Dr. Oren Shriki

Dept. of Brain and Cognitive Sciences
Ben-Gurion University of the Negev

The title of his talk is

EEG-Based Brain Computer Interfaces

Abstract

Brain Computer Interfaces (BCI) allow for direct communication between brain activity and external devices. They can be used for purposes of robot control and communication tools for disabled people. We currently explore in the lab three major BCI paradigms: P300, Motor Imagery (MI) and Steady-State Visually Evoked Potential (SSVEP).

The P300 approach is based on recording brain responses to brief stimuli and identifying whether the presented stimulus is relevant or irrelevant to the intent of the subject. The decision relies on the presence or absence of the P300 EEG component, which is associated with relevance in a given context. We constructed a classifier that uses two different machine learning algorithms, and takes the output of the one with the higher confidence. The classifier could reliably identify the choice of the subject and reached a maximal information transfer rate of 50 bits/min.

Motor imagery based BCIs take advantage of specific brain rhythms, namely changes in the spectral power, that occur following an imagination of a limb movement. We developed a graphical user interface, which provides feedback to the user and allows for exploring different training paradigms. In particular, we explore co-adaptive learning schemes, namely, the interaction between the human adaptation and the machine learning algorithm in the course of a few days.

The SSVEP approach relies on the idea that attending to an external visual stimulus elicits a corresponding EEG component with similar temporal properties. The subject is presented with multiple stimuli, each flickering at a unique frequency, and attends to one of them. The subject's intent is detected by identifying the corresponding frequency in the EEG recorded from visual areas.

Each of the above BCI paradigms has its own pros and cons. By combining multiple paradigms into a single integrated interface, it is possible to create BCI systems with higher versatility. Future work will focus on exploring hybrid BCI systems and on developing new BCI paradigms. We also started exploring the utility of BCI paradigms in the context of human-robot interaction.