Brain-Computer Interface Signal Processing

Motivation

A brain-computer interface (BCI) is a communication system that translates brain-activity into commands for a computer or other devices. In other words, a BCI allows users to act on their environment by using only brain-activity, without using peripheral nerves and muscles [1]. Among the several methods used for BCI, the P300 event-related potential is of particular interest due to its reliability and low subject training requirements. The P300 is a positive detection in the human EEG, appearing approximately 300ms after the presentation of rare or surprising, task-relevant stimuli [1]. In this project, we will go through the steps necessary to detect the presence of P300 signal in EEG and hence detect the kind of task the subject wants to perform. We will do that by reading a sample research paper on the topic and going through its code and running it to reproduce the results in the paper.

Design Problem

Given multi-channel EEG signals, detect the presence of P300.

Design Input

- Multi-channel EEG signals.
- Information about the present stimulus while acquiring the EEG signals.
- Matlab code to read, preprocess, and classify the EEG signals.

Design Output

- Sample classification accuracy and bitrate results for one subject that match that of [1].

Design Evaluation Criteria

- Quantitatively by confirming the match of the obtained results against that in the paper.

References

[1] Hoffmann, Ulrich; Vesin, Jean-Marc; Ebrahimi, Touradj; Diserens, Karin, “An efficient P300-based brain-computer interface for disabled subjects,” Journal of Neuroscience Methods, vol. 167, no. 1, p. 115-125, 2008. (Download at: http://infoscience.epfl.ch/record/101093)

[2] http://mmspg.epfl.ch/BCI_datasets