Dataset description

Hyperscanning brain-computer interface based on synchronous and asynchronous interindividual SSVEP signals

Experimental procedure

Pairs of participants (dyads) were presented with flicker stimuli while the EEG was recorded simultaneously using two g.USBamp amplifiers (gtec.at) and two sets of 10 active EEG electrodes, referenced against the right earlobes. The participants were seated next to each other, in front of custom-made stimulation devices, which were separated by a partition panel. During one trial, the participants focused on one of two small LED panels, which were 35mm wide, 35mm high and 18cm apart and flickered at a frequency of $9.\overline{09}$ Hz (left LED panel) and $11.\overline{1}$ Hz (right LED panel). The first trials served as training trials for classifier training, whereas target stimuli were cued by the experimenter and no feedback was presented. In the following trials, participants focused on the flicker stimuli depending on questions asked by the experimenter where they associated the left LED panel with ‘yes’ and the right LED panel with ‘no’. After 5s of stimulation, data were online synchronized and preprocessed. The BCI presented an auditory feedback by playing an artificially generated voice saying ‘equal’ if the BCI detected synchrony of brain waves and ‘different’ if asynchronous signals were predicted by the classifier. Afterwards, the participants pressed buttons, which allowed us to identify the LED panel they were focusing on. This data was then used to determine the ground truth, which is required for the training and evaluation of the classifier.

Associated publication

Reintsema L., Sweeney-Reed C.M., Dürschmid S., Hinrichs H., Reichert, C., 2024, submitted to the 9th Graz BCI Conference 2024.

Dataset

We provide 7 Matlab files, each containing simultaneously recorded EEG data from two participants. The EEG data are online preprocessed immediately after the stimulus interval ended as follows. The data were synchronized according to the start event trigger which was simultaneously sent to both amplifiers and epochs were cut. Due to time lags the lengths of the epochs vary between 5062ms and 5187ms. The epochs were notch filtered to remove 50Hz line noise and bandbass filtered between 5Hz and 30 Hz using a 4^{th} order Butterworth filter. Finally, we resampled the data from the recorded sampling rate of 512Hz to 256Hz.

Each *.mat file contains two structures:

- `subject`
  - `age:` age of both participants at time of recording
  - `sex:` 'm' or 'f' denoting male/female for both participants
  - `ID:` identifiers of both participants

- `bciexp`
  - `srate:` sampling rate
  - `data:` data recorded from EEG channels, segmented into trials; cell array of size nTrials × 2 (one column per participant)
  - `intention:` stimulus the participants focused, as derived from their button press responses; 1 corresponds to the lower flicker frequency and was associated with 'yes', 2 corresponds to the higher flicker frequency, i.e., the assumed ground truth used to train and test the classifier; size is nTrials × 2 (one column per participant)
  - `feedback:` brain-to-brain synchrony feedback the BCI determined online; 1 corresponds to 'equal'; 2 corresponds to 'different'; 0 denotes training trials where no feedback was provided
  - `synchroneity:` denotes whether the intention (flicker frequency which was focused) was the same or not; 1 corresponds to 'equal'; 2 corresponds to 'different'
  - `label:` names of the 10 recorded EEG channels according to the order in a `data` cell (which has 10 rows)
  - `stimperiod:` time of a single stimulus onset asynchrony in seconds. The first element corresponds to the lower flicker frequency, which was associated with 'yes'; the second element corresponds to the higher flicker frequency, which was associated with 'no'; essentially it is the reciprocal of the stimulus flicker frequencies