Dataset description

Associated publication

Reichert, Christoph, Stefan Dürschmid, Catherine M Sweeney-Reed, and Hermann Hinrichs. 2022. “Visual Spatial Attention Shifts Decoded from the Electroencephalogram Enable Sending of Binary Messages.” In 2022 IEEE Workshop on Complexity in Engineering (COMPENG), 1–4. Florence. https://doi.org/10.1109/COMPENG50184.2022.9905445.

Experimental procedure

Participants were presented with a sequence of ten visual stimuli (comprising a single trial) in which red and green laminar light stimuli were simultaneously presented in opposite visual hemifields (green left and red right or vice versa). The order of presentation side of each type was pseudo-randomized. Stimuli were presented at a 9.1° visual angle (va) to the left and right of a fixation cross, size of the laminar stimulus was 3.1° by 4.4° va. Stimulus onset asynchrony was 850–1100 ms. Participants were asked to associate the green stimulus with the word "yes" and the red stimulus with the word "no" while responding to the question whether an acoustically presented number was even or not. They communicated their response only by directing their attention to the respective color illumination, while fixating their visual gaze on a cross in the center of the stimulus device. The online decoded response was auditorily presented as feedback with a female voice saying "yes" or "no". One run consisted of 12 trials. The first two runs served as training runs, i.e. no auditory cue or feedback was presented but the subjects shifted attention to one color (green in first, red in second run) the entire run. Afterwards, ten runs were performed in closed-loop feedback mode.
EEG was recorded with a BrainAmp DC amplifier using 12 active electrodes at positions P7, P5, P3, P4, P6, P8, PO7, PO3, PO4, PO8, O1 and O2, referenced against the right mastoid. Furthermore, the horizontal and vertical electrooculogram (EOG) was recorded. Sampling rate was 250 Hz and a 0.1 Hz highpass filter but no notch filters were applied by the recording software.

Aim of the BCI

The BCI is intended for the decoding of binary decisions from a series of stimuli. The decoding task is to determine to which of the simultaneously presented laminar color stimulation the participant shifted his/her attention. Assuming that the attention is always shifted to the visual field in which the target is presented, we can determine the target color (corresponding with a “yes”/”no” response to the presented question) from the stimulus sequence.

Dataset

We provide 14 Matlab files, each containing EEG data from one participant.
Each file contains two structures:

- `subject`
  - `age:` age at time of recording
  - `sex:` ‘male’ or ‘female’
  - `handedness:` ‘left’ or ‘right’
  - `language:` language in which questions and feedback were presented
  - `ID:` participant identifier

- `bciexp`
  - `srate`: sampling rate
  - `data:` data recorded from EEG channels, segmented into trials
  - `heog:` horizontal EOG (bipolar), segmented into trials
  - `veog:` vertical EOG (bipolar), segmented into trials
  - `stim:` trigger channels, which show stimulus onsets
1st channel: 1 - green left / red right, else 0
2nd channel: 1 - red left / green right, else 0
  - `intention:` response participant intended to give, i.e., the assumed ground truth used to train and test the classifier
  - `feedback:` response the BCI determined online; empty if no feedback was provided
  - `feedbacksamp:` time point when feedback was presented
  - `expected:` response expected to a question
  - `label:` names of EEG channels according to order in `data`
  - `targetside:` trigger channel, which shows the presentation side of the target as determined from the fields `stim` and `intention`:
1 - target presented right, -1 – target presented left, else 0

Example code

As an example, how the data could be analyzed, we provide code as part of this dataset. This code requires the ERPCCA toolbox:

https://gitlab.com/christoph.reichert/erpcca