

EEG Data for Voluntary Finger Tapping Movement

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1. PROJECT

Title: Investigation of Temporal Dynamics of EEG during Voluntary Movement Intention for Applications in Brain Computer Interface (BCI)

Dates: June 2014 – September 2018

Funding Organisation: University of Reading, UK

2. DATASET

Title: EEG Data for Voluntary Finger Tapping Movement

Description: This dataset consists of EEG data recorded during voluntary asynchronous index finger tapping from 14 healthy individuals for investigating the temporal dynamics of EEG associated with motor intention. EEG was recorded using TruScan Deymed amplifier with 19 channels according to 10-20 international system for three conditions - right finger tap, left finger tap and resting state with sampling frequency of 1024Hz. 120 trials were collected per participant with 40 trials for each of the three conditions. This dataset consists of 6s EEG trials that were segmented after pre-processing and artefacts removal using Independent Component Analysis. Two additional channels are included containing finger tapping movement recorded using a bespoke microcontroller tapping device to mark the exact location of finger tap. The 6s trials were segmented from -3s to +3s with respect to the onset of the finger tap are included in this dataset.

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Organisation: University of Reading, UK

Rights-holder: Maitreyee Wairagkar

3. TERMS OF USE

Copyright Maitreyee Wairagkar 2017. This dataset is licensed by the rights-holder under a Creative Commons Attribution 4.0 International Licence: <https://creativecommons.org/licenses/by/4.0/>.

4. CONTENTS

Following files are available:

- README document with the description of the EEG Data
- EEG finger tapping data for 14 participants provided in zipped MATLAB 2014 Data files (*.mat)

5. METHOD AND PROCESSING

Participants

EEG was recorded from 14 healthy participants (8 female, age 26 ± 4 years, 12 right handed (Participant number 1 and 6 were left handed)). Ethical approval for EEG experiment was obtained from the Ethics committee of School of Systems Engineering, University of Reading, UK. All the participants gave informed written consent before beginning the experiment. The participants in this study did not have any previous experience with EEG experimentation or BCI.

Experimental Paradigm

EEG data was recorded during asynchronous voluntary index finger tapping movement for three conditions – right finger tap, left finger tap and resting state. Fixation cross was displayed on the screen for 2s followed by instruction for right tap, left tap or resting state which stayed on the screen for 10s. Participants were given 10s window to perform a single voluntary finger tap according to the instruction at any time of their choice. They were instructed not to tap immediately after the display of the instruction to avoid the effect of the cue. During resting state trials, participants were asked to stay still without thinking of anything in particular. Each trial was followed by a random break of 1 to 1.5s with blank screen. The structure of single trial is shown in Figure 1. The instructions for right tap, left tap and resting state were displayed randomly to avoid any effect of repeated pattern.

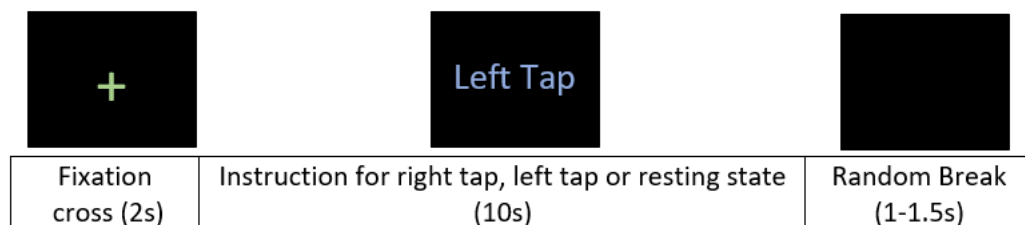


Figure 1. Structure of a single trial

Data Recording

The experimental paradigm was created in Simulink using BioSig toolbox [1]. EEG was recorded using TruScan Deymed amplifier with **19 channels** according to 10-20 international system with ground on FPz and reference on FCz. A microcontroller device was created to record finger tapping to mark the onset of the finger tap. **Two additional channels** for right and left finger tap were co-registered with EEG using

TOBI framework [2]. The tapping channels recorded binary signal with value of 1 for no finger movement and 0 for finger tap. Participants were seated in a comfortable chair by placing their hands on the table with index fingers of both the hands in the tapping device. Signals were recorded with sampling frequency of 1024Hz. 40 trials per condition (right tap, left tap, resting state) were recorded for each participants.

Pre-Processing and Artefacts removal

Pre-processing and artefacts removal was done in EEGLAB [3] and MATLAB as follows:

DC offset removal: Baseline was removed from the signal by subtracting the mean. Additionally, a high-pass filter with cut-off frequency of 0.5Hz was used.

Power line noise removal: Power line noise was removed using a notch filter at 50Hz.

High frequency noise removal: High frequency noise was removed using a low-pass filter with cut-off frequency of 60Hz.

Artefacts removal: Artefacts were removed using Independent Component Analysis provided by EEG lab. The independent components were identified and rejected manually. The artefacts free reconstructed signal was also inspected visually.

Trial segmentation: 6s EEG trials were segmented by extracting the signal from -3s to +3s from the onset of the finger tap marked by the channels 20 and 21 for the right and left tap respectively that were recorded by the microcontroller tapping device. For, the resting state trials, last 6s from each 10s trial before the break as shown in Figure 1 were extracted.

6. DATA FILE DISCRIPTION

The dataset in a zipped folder consists of MATLAB (*.mat) data files for 14 participants named as Participant1 ... Participant14. Data for each participant is stored as MATLAB cell array. The format of the cell array is (21 channels × 3 conditions × 40 trials) consisting 6s trials with sampling frequency of 1024Hz, e.g. Participant1(21×3×40).

The finger tap movement onset is at 3s (sample number 3072) which is seen in channel 20 (Rt) for right tap and channel 21 (Lt) for left tap with value of 0 for movement and 1 for no movement. During resting state conditions, all the values in channel 20 and 21 are 1 as there is no movement.

Order of all the channels:

Fp1	Fp2	F7	F3	Fz	F4	F8	T3	C3	Cz	C4	T4	T5	P3	Pz	P4	T6	O1	O2	Rt	Lt
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Order of conditions:

Right finger Tap	Resting state	Left Finger Tap
1	2	3

Example MATLAB commands:

```
e.g.1. To obtain trial number 34 for right finger tapping from participant 1 for channel C3
>>EEGtrail = Participant1{9,1,34};
>>Fs = 1024;
>>Time = (1:Fs*6)/Fs;
```

```
>> plot(time,EEGtrail); xlabel('Time (s), movement onset at 3s');  
ylabel('EEG amplitude (\muV)');
```

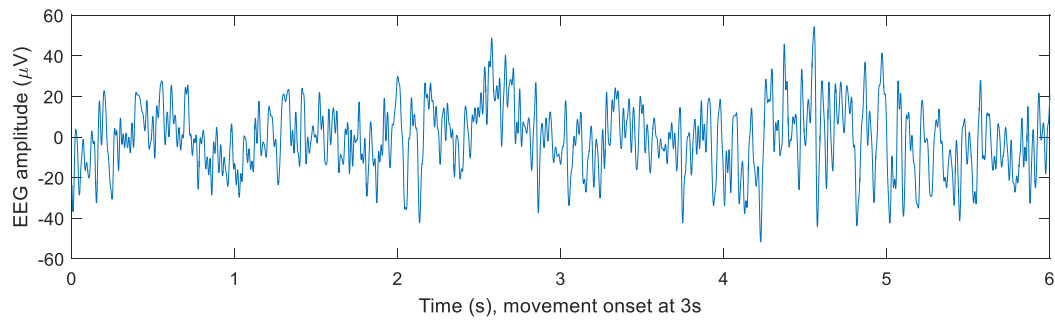


Figure 2. Plot of single EEG trial from channel C3

e.g.2. To obtain trial number 15 for left finger tapping from participant 7 for channel P4

```
>>EEGtrail = Participant7{16,3,15};
```

e.g.3. To obtain trial number 20 for resting state from participant 12 for channel Fz

```
>>EEGtrail = Participant12{5,2,20};
```

Note: Participant number 2 has 35 trials per condition, rest of the participants have 40 trials.

REFERENCES

- [1] C. Vidaurre, T. H. Sander and A. Schlogl, "BioSig: the free and open source software library for biomedical signal processing," *Computational intelligence and neuroscience*, 2011.
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- [3] A. Delorme and S. Makeig, "EEGLAB: An open source toolbox for analysis of single-trial EEG dynamics including independent component analysis," *Journal of Neuroscience Methods*, vol. 134, no. 1, pp. 9-21, 2004.