Dataset Description

Upper limb movements can be decoded from the time-domain of low-frequency EEG

Associated Publication

Ofner P, Schwarz A, Pereira J, Müller-Putz GR (2017) Upper limb movements can be decoded from the time-domain of low-frequency EEG. PLOS ONE 12(8): e0182578.

Experimental Paradigm

This data set consists of electroencephalography (EEG) data from 15 healthy subjects aged between 22 and 40 years with a mean age of 27 years (standard deviation 5 years). Nine subjects were female, and all the subjects except s1 were right-handed.

Subjects sat on a chair and their right arm was fully supported by an exoskeleton with anti-gravity support (Hocoma, Switzerland) to avoid muscle fatigue. We measured each subject in two sessions on two different days, which were not separated by more than one week. In the first session the subjects performed motor execution (ME), and motor imagination (MI) in the second session. The subjects performed six movement types which were the same in both sessions and comprised of elbow flexion/extension, forearm supination/pronation and hand open/close; all with the right upper limb. All movements started at a neutral position: the hand half open, the lower arm extended to 120 degree and in a neutral rotation, i.e. thumb on the inner side. Additionally to the movement classes, a rest class was recorded in which subjects were instructed to avoid any movement and to stay in the starting position. In the ME session, we instructed subjects to execute sustained movements. In the MI session, we asked subjects to perform kinesthetic MI.

The paradigm was trial-based and cues were displayed on a computer screen in front of the subjects. Figure 1 shows the sequence of the paradigm. At second 0, a beep sounded and a cross popped up on the computer screen. Afterwards, at second 2, a cue was presented on the computer screen, indicating the required movement (or rest). At the end of the trial, subjects moved back to the starting position. In every session, we recorded 10 runs with 42 trials per run. We presented 6 movement classes and a rest class and recorded 60 trials per class in a session.

Figure 1: Trial sequence. At second 0 a cross appeared together with a beep sound; at second 2 the cue was presented and subjects executed/imagined a sustained movement or avoided any movement, respectively. After the trial, a break with a random duration of 2s to 3s followed.

Data Acquisition

The EEG was measured from 61 channels covering frontal, central, parietal and temporal areas using active electrodes (g.tec medical engineering GmbH, Austria). Reference was placed on the right mastoid, ground on AFz. We used an 8th order Chebyshev bandpass filter from 0.01 Hz to 200 Hz and sampled with 512 Hz. Power line interference was suppressed with a notch filter at 50 Hz. In addition we measured the arm joint angles for the exoskeleton using customized software and finger positions with a 5DT Data Glove (5DT, USA) for determining movement onsets.

Data Set Description

The data set comprises of GDF files for each subject, session and run. The cues are coded as events, see Table 1 for the corresponding event codes. Table 2 shows the channel labels indicating the EEG electrode positions (1-61), the EOG positions (62-64), the data glove sensors (65-83), and the exoskeleton sensors (84-96).

Table 1: Event codes.

class	elbow flexion	elbow extension	supination	pronation	hand close	hand open	rest
event code	0x600	0x601	0x602	0x603	0x604	0x605	0x606

Table 2: Channel labels.

channel	label	channel	label	channel	label	channel	label
1	F3	25	FCC6h	49	CPP5h	73	middle ring
2	F1	26	FTT8h	50	CPP3h	74	ring near
3	Fz	27	C5	51	CPP1h	75	ring far
4	F2	28	C3	52	CPP2h	76	ring little
5	F4	29	C1	53	CPP4h	77	little near
6	FFC5h	30	Cz	54	CPP6h	78	little far
7	FFC3h	31	C2	55	P3	79	thumb palm
8	FFC1h	32	C4	56	P1	80	-
9	FFC2h	33	C6	57	Pz	81	-
10	FFC4h	34	TTP7h	58	P2	82	-
11	FFC6h	35	CCP5h	59	P4	83	-
12	FC5	36	CCP3h	60	PPO1h	84	hand X
13	FC3	37	CCP1h	61	PPO2h	85	hand Y
14	FC1	38	CCP2h	62	EOG left	86	hand Z
15	FCz	39	CCP4h	63	EOG middle	87	elbow X
16	FC2	40	CCP6h	64	EOG right	88	elbow Y
17	FC4	41	TTP8h	65	thumb near	89	elbow Z
18	FC6	42	CP5	66	thumb far	90	shoulder adduction
19	FTT7h	43	CP3	67	thumb index	91	shoulder flexion/extension
20	FCC5h	44	CP1	68	index near	92	shoulder rotation
21	FCC3h	45	CPz	69	index far	93	elbow

22	FCC1h	46	CP2	70	index middle	94	pro/supination
23	FCC2h	47	CP4	71	middle near	95	wrist flexion/extension
24	FCC4h	48	CP6	72	middle far	96	-