Exercise 0: Introduction to MATLAB

If you are not familiar with Matlab and did not have the time to go through the tutorial, then please refresh your knowledge before starting with exercise 1!

Exercise 1: Spatial filters

Artifacts are a major issue in BCI. One way to reduce the impact of artifacts are spatial filters. In this exercise you will study the effects of different spatial filters on artifact-contaminated EEG.

The file `artifacts.mat` contains a segment of a 120 channel EEG recording that is contaminated with artifacts. Use the MATLAB function `load` to load the .mat file. The EEG is sampled at a rate of 500 Hz and band pass filtered between 1 Hz and 200 Hz. Electrode setup and channel information are shown on the next pages. Please compute the following spatial filters for positions Fz, Cz and Oz:

Exercise 1.1: Bipolar derivation $X_{bip} = X_{anterior} - X_{posterior}$

Exercise 1.2: Laplace derivation $X_{lap} = X - \frac{1}{4}\left(X_{anterior} + X_{dexter} + X_{posterior} + X_{sinister}\right)$

Exercise 1.3: Common average reference derivation (CAR) $X_{CAR} = X - average(all\ channels)$

> Task:
> - Describe the effects of the different spatial filters on the EEG signal, especially on artifacts.

Exercise 2: P300 Evoked Potentials

The file `BI5_segments_HTS.mat` contains data from an auditory P300 BCI experiment. Study participants were asked to concentrate on a target tone, which was higher than the non-target tone. The multidimensional matrix `segments` stores the following information:

- First dimension: Channels (Fz, Cz and Pz, you can look that up in "ch_selection").
- Second dimension: Time course (77 time points, Sample rate: 64 Hz).
- Third dimension: Trials (2200).

Use the `classlabels` vector to identify non-target trials (class 1) and target trials (class 2). Store them in separate matrices and calculate their means.

> Tasks:
> - Compute the EPs by averaging the trials for each channel and modality (non-target and target) separately.
> - Plot a figure for each channel with the two modalities (`hold on`).
> - Describe the differences between the two modalities (P300).
> - Are the differences the same for all channels?

Pre-submission via TeachCenter at the end of the unit; final submission 25.03.2018

EASYCAP

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Montage No. 15
See coordinates measured[i] from a real head in "M15-ext-ThetaPhi.xls".

Electrode Names:

X:\AL-Arbeitsanleitungen\Montagen nummeriert\M15.doc

Electrode positions:

1	Fp1	51		101	
2	Fpz	52	FT9	102	CCP8
3	Fp2	53	FAF5	103	TP8
4	AFp1	54	F5	104	P10
5	AFp2	55	FFC7	105	CFC4
6	AF3	56	FT7	106	C4
7	AFz	57	F3	107	CCP6
8	AF4	58	FFC5	108	CP6
9	FAF1	59	FC5	109	PCP8
10	FAF2	60	CFC7	110	P8
11	F1	61	T7	111	PO10
12	Fz	62	FFC3	112	CCP4
13	F2	63	FC3	113	CP4
14	FFC1	64	CFC5	114	PCP6
15	FFC2	65	C5	115	P6
16	FC1	66	CCP7	116	PO8
17	FCz	67	TP7	117	OPO10
18	FC2	68	P9	118	PCP4
19	CFC1	69	CFC3	119	P4
20	CFC2	70	C3	120	PPO6
21	C1	71	CCP5	121	EMG1SL
22	Cz	72	CP5	122	EMG1IL
23	C2	73	PCP7	123	EMG2SL
24	CCP1	74	P7	124	EMG2IL
25	CCP2	75	PO9	125	EMG1SR
26	CP1	76	CCP3		
27	CPz	77	CP3		
28	CP2	78	PCP5		
29	PCP1	79	P5		
30	PCP2	80	PO7		
31	P1	81	OPO9		
32	Pz	82	PCP3		
33	P2	83	P3		
34	PPO1	84	PPO5		
35	PPO2	85	AF8		
36	PO3	86	F10		
37	POz	87	F8		
38	PO4	88	FT10		
39	OPO1	89	FAF6		
40	OPO2	90	F6		
41	O1	91	FFC8		
42	Oz	92	FT8		
43	O2	93	F4		
44	OI1	94	FFC6		
45	OI2	95	FC6		
46	I1	96	CFC8		
47	Iz	97	T8		
48	I2	98	FFC4		
49	AF7	99	FC4		
50	F9	100	CFC6		
	F7		C6		