Project 5 Longitudinal analyses on MI BMI data

About Learning and Motor logical point of view

12 pages in English, quality of the figures, structure of the report, pdf (word or latex)

Objective:

We have data from 1 subject only, a disable subject, data for a long period of time,

We want to perform some longitudinal analysis of this motor imagery (MI) data collected during the Cybathlon training of pilot F1 and highlight the learning correlate

Learning correlate : **last lesson of Wednesday (lesson 17 (2021.01.13),** the evolution for instance of the fisher score over time, the correlation between the fisher score and the accuracy, the classifier but also accuracy at the application level that in this case are the target hit/ target miss events, so when the subject was able to fit the bar of the left or on the right

Data description:

Data has been recorded with 16-channel EEG amplifier (g.USBamp, g.Tec) at 512 Hz.

Electrodes were placed accordingly to the 10-20 standard layout. Position and order of the electrodes are reported in Figure A.

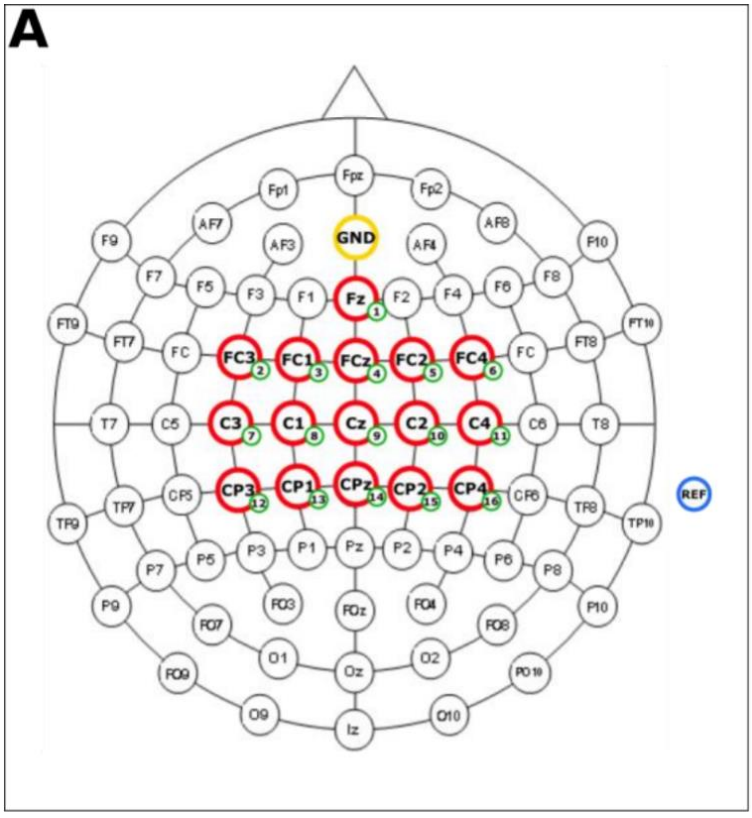

Figure 1: 16-channel layout. Red circles indicate the electrode positions, small green circles the electrode number

The provided data covers a period of 3 months of training (11 sessions). During the period, the pilot performed “offline” (calibration, no real feedback) and “online” (with real feedback) runs. The number of trials for each run may be different. Event codes are reported in Figure C.

C

Code	Description	Decimal value
0x0001	Trial start	1
0x0312	Fixation cross	786
0x0305	Both Hand	773
0x0303	Both Feet	771
0x030F	Rest	783
0x030D	Continuous feedback	781
0x0381	Target hit	897
0x0382	Target miss	898
0x8000	Event OFF	/

Figure 2: Event codes in the GDF

The task and the visual paradigm: The pilot was asked to perform 2 motor imagery tasks: both hands vs. both feet. The visual paradigm exploited during the training is illustrated in Figure B. The color of the cue indicated which motor imagery task to perform (e.g., both hands or both feet). During the calibration runs, the bar associated to the cue was automatically filled. During the online runs, the bars were filled accordingly to the output of the classifier.

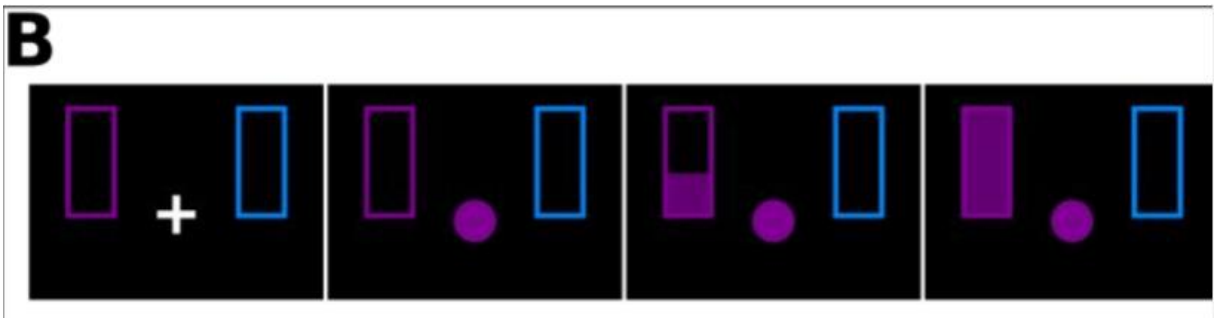

Figure 3: Example of visual paradigm used in the offline and online training of the pilot

Assignments:

1. Analyse the data with the same techniques and method provided in class:

- Laplacian
- Psd
- Feature selection
- Feature extraction
- Classification with train the classifier with the ‘flying’ data
- Try to evaluate with classifier for this subject

2. **The Main point:** extract the metrics to evaluate learning

- At the neurophysiological level: the fisher score of this subject for each run (the different session), to highlight if there is learning in the data we have. See if there is a trend over time
- The application level : BCI command accuracy (we can compute by target hit/target miss event that we have in the gdf, that is to say if the subject was able to reach the threshold of the feedback from target miss and hit in the gdf) and also the decoder accuracy (the output of classifier without integration)

3. Report and discuss the temporal evolution of learning correlates of such metrics and the correlation between them
4. OPTIONAL : create the model (the classifier) and try to also correlate the learning of the subject with these new metrics (so the output of the classifier as is the lesson) and also you can do something just by analysing, extracting this temporal evolution of the feature of the fisher score, you can try to propose the best moment during the training phase to recalibrate the classifier

References:

Other data of 2016 in moodle, there is all the analysis and the method they used (the same method of the lesson) : S. Perdikis, L. Tonin et al. “The Cybathlon BCI race: Successful longitudinal mutual learning with two tetraplegic users,” PLOS Biol., vol. 16, no. 5, p. e2003787, May 2018.