Neural data-analysis Workshop Oren Shriki, Erez Wolfson, Nir Friedman

Exercise #4 – Identifying individual alpha frequency

Background

- The alpha frequency band usually refers to brain activity in the range of 8-12 Hz. However, the peak frequency and the width of the peak vary from one subject to another.
- The goal of this exercise is to extract the Individual Alpha Frequency (IAF) of a subject, namely the peak frequency of his alpha activity.

1. Data handling

- The data for each of the 3 subjects contain two files with resting state EEG, one with eyes open (EO) and one with eyes closed (EC). Each data file contains a matrix, in which each row corresponds to a different channel and each column to a different time point. We will focus on channel 19 (electrode Pz). The sampling rate is 256 Hz.
- Place all the data files in one directory and name it '..\DATA_DIR\'.
- **Note that the format for naming the data files is not strict, (**e.g. space and '_' may alternate …). Make sure your code can handle any file name as long as it contains subject number and one of the tags 'EO' or 'EC', (use the Wildcard character '*').
- **The code must be able to run over n subjects.** To test this property you can make multiple copies of the data from the same subject and give it different names (e.g. ' subject1_ EC.edf' → 'subject99_ EC.edf').
- Load the files using the command edfread (the file can be found on moodle).

2. Drawing power spectra

- For each subject, plot the EC and EO power spectra on a single plot and compare them.
- Find the optimal frequencies band to picture Alpha waves (at list 8 Hz wide) From now on show the results only in that range.

- First, calculate the power spectra using the **`fft`** command.
  Next, calculate the power spectra using **`pwelch`**, which divides the data into windows and then averages the power spectrum over these windows.
- Play with the parameters of this function. For example, to obtain the spectrum for the frequencies 4:0.1:14 with a window of 5 times the sampling gap and no overlap between windows use:

```
f = 4:0.1:14;
fs = 256;
window = 5*Fs;
noverlap = [];
pwelch(x, window, noverlap, f, fs);
```

3. Finding the IAF

- Calculate the difference spectrum by subtracting the EO spectrum from the EC spectrum.
- Find the frequency at which the difference spectrum attains its maximum. This frequency is defined as the IAF of the subject.
- Perform this analysis using both the direct **`fft`** approach and the **`pwelch`** approach.

4. General reequipments and deliverables

- You must use at list 2 functions.
- Avoid using magic numbers !
- Submit according to the submission guidelines in Moodle.
- Describe **briefly** what you have done and accompany your results with discussion.
- Include 4 figures for each of the 3 subjects:
  1. EC and EO power spectra using **`fft`**.
  2. Difference spectrum using **`fft`** including a vertical line marking the IAF.
  3. EC and EO power spectra using **`pwelch`**.
  4. Difference spectrum using **`pwelch`** including a vertical line marking the IAF.