2025-2026 | Neurorobotics

Lab05 | ERD/ERS on spectrogram

1. Write a MATLAB script to load and process each GDF file separately

Create a MATLAB script that performs the following steps for each GDF file:

- Load the offline GDF file
- Apply the Laplacian filter. Use the Laplacian mask provided in the moodle.
- Compute the PSD over time exploiting the function `proc_spectrogram()` provided in the moodle. The parameters for the function are:

```
>> % data [samples x channels]
>> wlength    = 0.5;    % seconds. Length of the external window
>> pshift     = 0.25;   % seconds. Shift of the internal windows
>> wshift     = 0.0625; % seconds. Shift of the external window
>> samplerate = h.SampleRate;
>> mlength    = 1;      % seconds
>> [PSD, f]   = proc_spectrogram(data, wlength, wshift, pshift, samplerate,
mlength);
```

- Select only a subset of frequency from the PSD. Use the frequency grid to select meaningful frequencies (e.g., from `4 Hz` to `48 Hz`, step `2 Hz`)
- Recompute the `h.EVENT.POS` and `.DUR` with respect to the PSD windows (you can use the provided function `proc_pos2win()`)

```
>> winconv = 'backward';
>> POS = proc_pos2win(events.POS, wshift*h.SampleRate, winconv,
wlength*h.SampleRate)
```

- Save the PSDs, the selected frequencies, the events, and all the information you consider relevant into a .mat file with the same name of the processed GDF (e.g., `ah7.20170613.161402.offline.mi.mi_bhbf`**`.mat`**)

2. Write a MATLAB script to load the processed data and to compute the ERD/ERS

Create a MATLAB script that performs the following steps with the processed data:

- Load each `.mat` file that you have processed
- Concatenate the files
- Extract and concatenate the events
- Create a matrix `Activity [windows x frequencies x channels x trials]`. Each trial ranges from the event related to the fixation cross (`TYP=786`) to the end of the event related to the continuous feedback (`TYP=781`)
- Create a matrix `Reference [windows x frequencies x channels x trials]` related only to the fixation period
- Compute the ERD/ERS for each trial exploiting these two matrices
- Select meaningful channels for the motor imagery task

- Visualize the ERD/ERS averaged across trials for the two MI classes (hint: use the function `imagesc()`)

Expected results