2025-2026 | Neurorobotics
Lab06 | ERD/ERS on logarithmic band power

1. Logarithmic band power

Import and concatenate all the offline GDF files and compute the band power. With respect to the previous exercise, apply a laplacian spatial filter to the data. Here a reminder about the steps to be implemented:

a. Apply a laplacian filters by exploiting the mask provided in the moodle:

```
>> load('laplacian16.mat');
>> s_lap = s*lap;
```

where s *is the data matrix* `[sample x channels]`
where `lap` *is the laplacian mask* `[channels x channels]`

b. Filter the signal in the μ and β bands
   - Use a Butterworth filter (choose the order and cutoff frequencies).
   - Apply zero-phase filtering with MATLAB's filtfilt function.
   - To verify the stability of the filter, you may use the fvtool() function.
c. Rectify the signal (square it).
d. Apply a moving average using a 1-second window.
e. ~~Apply a logarithmic transform to the result.~~
   we do not apply the log, since the data will be normalized with the ERD/ERS
f. Extracting trials for the two MI tasks

2. Event related desynchronization and synchronization (ERD/ERS)

Compute the ERD/ERS of the data by considering the fixation period as reference period and the continuous feedback as activity period.

```
>> Reference = repmat(mean(FixData), [size(TrialData, 1) 1 1]);
>> ERD = 100 * (TrialData - Reference)./ Reference
```

where `FixData` *refers to the fixation period* `[samples x channels x trials]`;
where `TrialData` *is refers to the whole trial period* `[samples x channels x trials]`

3. Temporal visualization
a. Select a meaningful channel
b. Average the ERD/ERS across trials for the two classes
c. Plot the average and the standard error of the ERD/ERS over time for the two classes

4. Spatial visualization

a. Visualize the topographic maps of the average ERD/ERS during the Reference Period and the Activity period

```
>> load('chanlocs16.mat');
>> ERD_Ref_771 = mean(mean(ERD(FixPeriod(1):FixPeriod(2), :, Ck == 771, 3), 1);
>> ERD_Act_771 = mean(mean(ERD(CFPeriod(1):CFPeriod(2), :, Ck == 771, 3), 1);
>> topoplot(squeeze(ERD_Ref_771), chanlocs16);
>> topoplot(squeeze(ERD_Act_771), chanlocs16);
```

Expected results