

2025-2026 | Neurorobotics  
**Lab04 | MI BMI Logarithmic band power**

## 1. EEG Data

Import all the offline **GDF files** provided in the previous assignment. Write a MATLAB script that performs the following steps:

1. **Load** the offline GDF files.
2. **Concatenate** the GDF files.
3. **Extract and concatenate** the corresponding event information.

## 2. Data Processing

At this point, you should have a single matrix of size **[samples × channels]** containing all the data from the different GDF files. You should also have an **EVENT** structure with all the events (**TYP**, **POS**, **DUR**) correctly concatenated.

Write a MATLAB script to process the data and compute the **logarithmic band power**. In particular, implement the following steps:

- a. **Filter** the signal in the  $\mu$  and  $\beta$  bands
  - o Use a Butterworth filter (choose the order and cutoff frequencies).
  - o Apply zero-phase filtering with MATLAB's `filtfilt` function.
  - o To verify the stability of the filter, you may use the `fvttool()` function.
- b. **Rectify** the signal (square it).
- c. Apply a **moving average** using a 1-second window.
- d. Apply a **logarithmic transform** to the result.

## 3. Trial Extraction

Extract trials corresponding to the **two motor imagery (MI) tasks**.

- a. Use the event types (**EVENT.TYP**) to identify which tasks correspond to which class.
- b. You may assume that a trial lasts from the **fixation cross** to the **end of the continuous feedback** period.

## 4. Visualization

- a. Select **three meaningful EEG channels**.
- b. Plot the **raw** and **filtered** signals for a given trial and for the selected channels
- c. Plot the power of the three channels after **averaging across all trials** for each class.

## Expected Results

You should obtain and analyze the **averaged logarithmic band power** in the  $\mu$  and  $\beta$  frequency bands for the two MI classes.

