Biomedical Robotics

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Title: EEG Data Analysis

Contents

1 STARTING THE DATA ANALYSIS

Using the GUI, we completed the following steps:
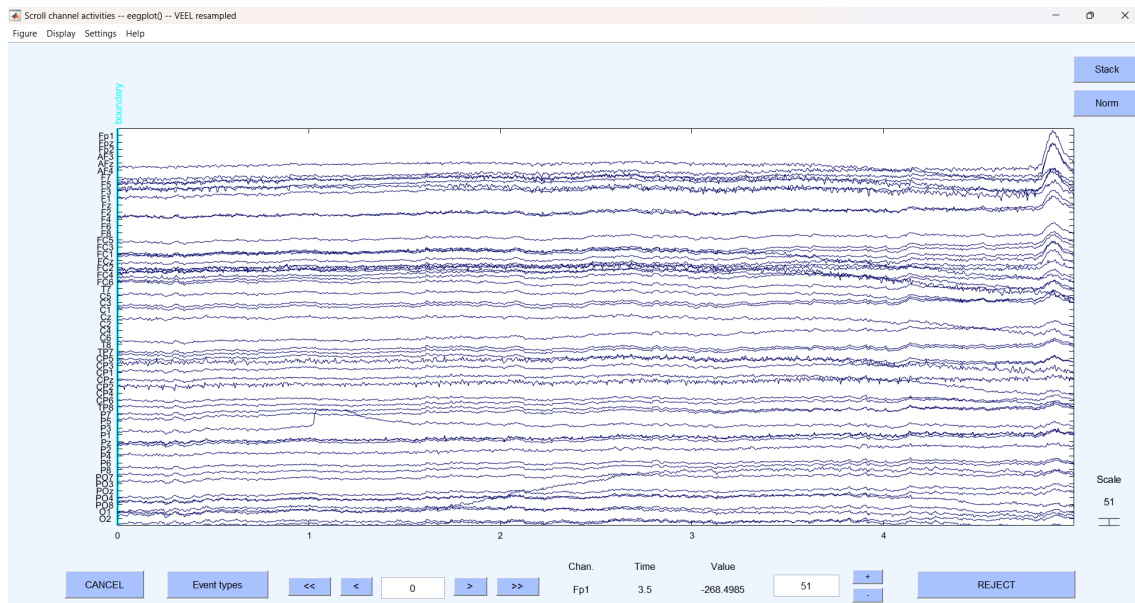
1.1 Downsampling 250 Hz

Figure 1

1.2 Filtering [1-80Hz] + Notch filter 50 Hz

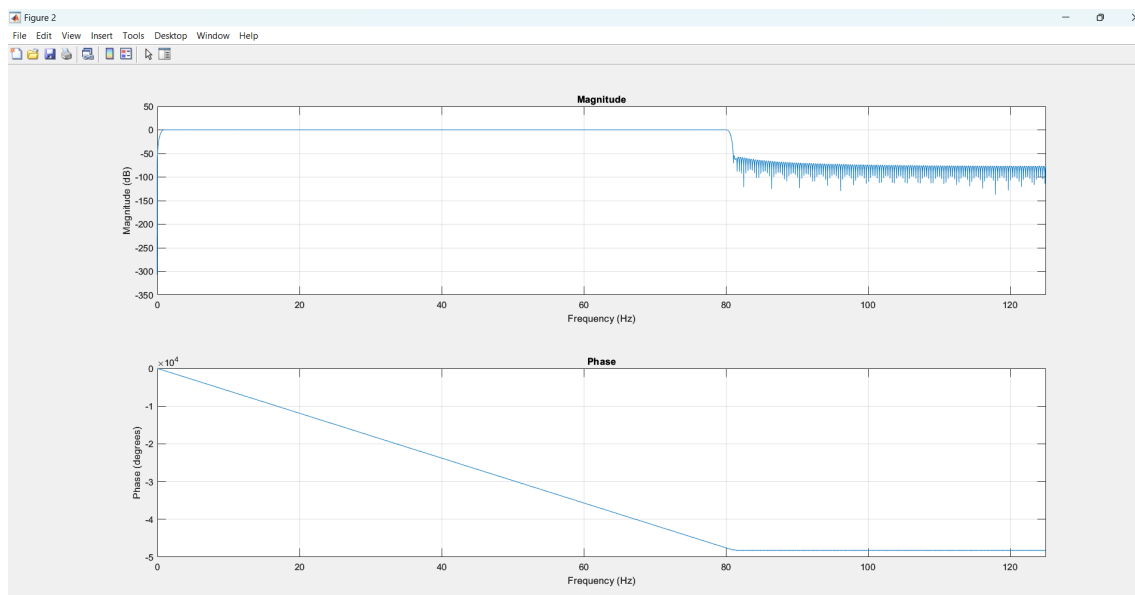In order to visualize the data, it is good practice to filter them

Figure 2

1.3 c) Epoching: Time locking event type: G interval: [-1 3]

For preprocessing and processing, it is useful to have epoched data. Epoching means dividing the recording into segments each one aligned to a specific event
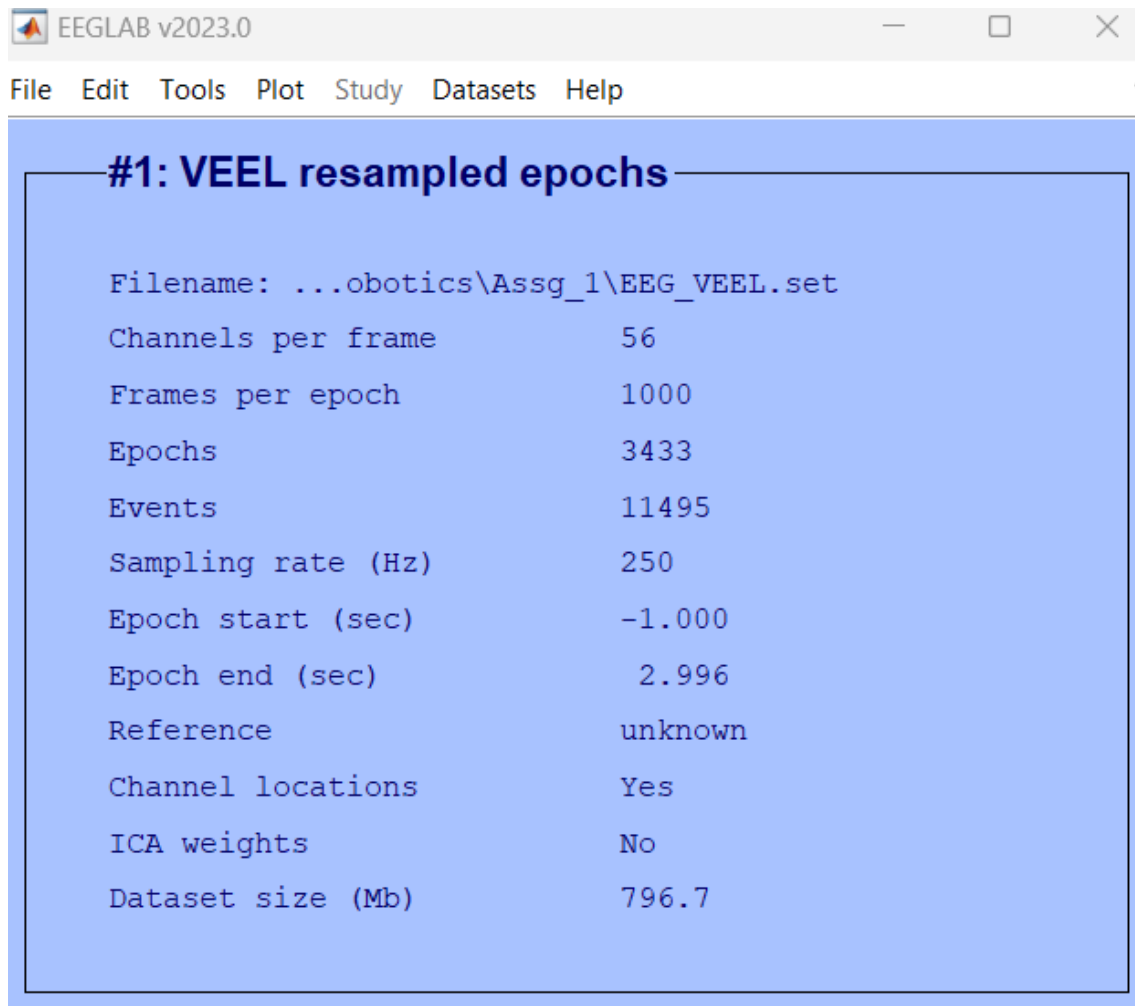

EEGLAB v2023.0

File   Edit   Tools   Plot   Study   Datasets   Help

#1: VEEL resampled epochs

Filename: ...obotics\Assg_1\EEG_VEEL.set	
Channels per frame	56
Frames per epoch	1000
Epochs	3433
Events	11495
Sampling rate (Hz)	250
Epoch start (sec)	-1.000
Epoch end (sec)	2.996
Reference	unknown
Channel locations	Yes
ICA weights	No
Dataset size (Mb)	796.7

Figure 3

2 Visual inspection for channels and epochs: Channel Data (scroll)

2.1 Remove bad epochs from the plot
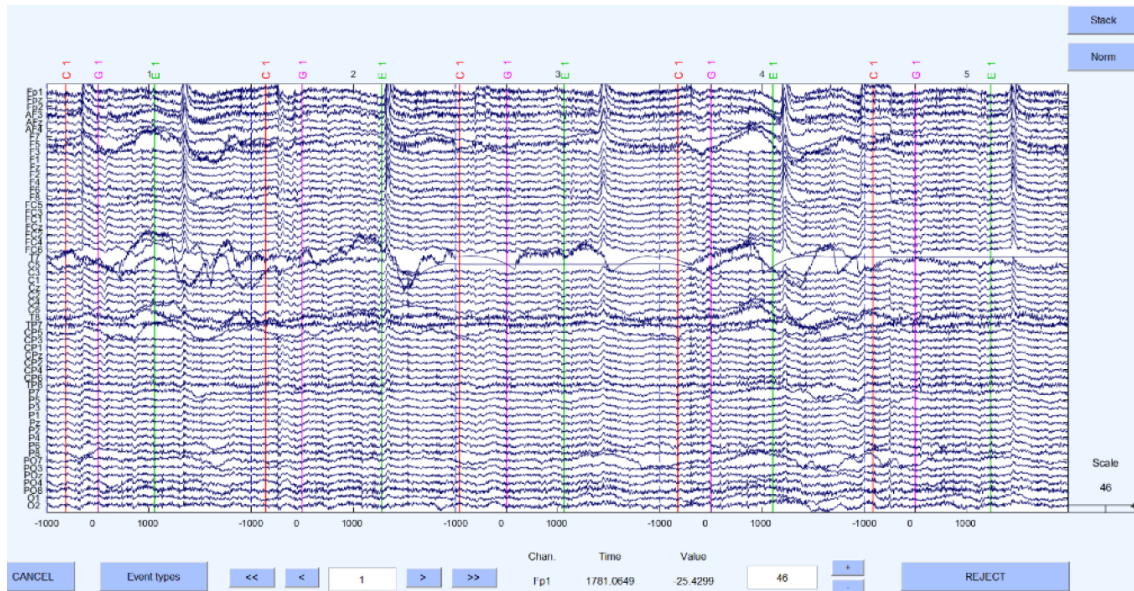
2.2 Select bad channels and remove them using the GUI

Figure 4

Here are the channels that we removed: **AF3 T8 TP7 T7 P6 P8 CP6**

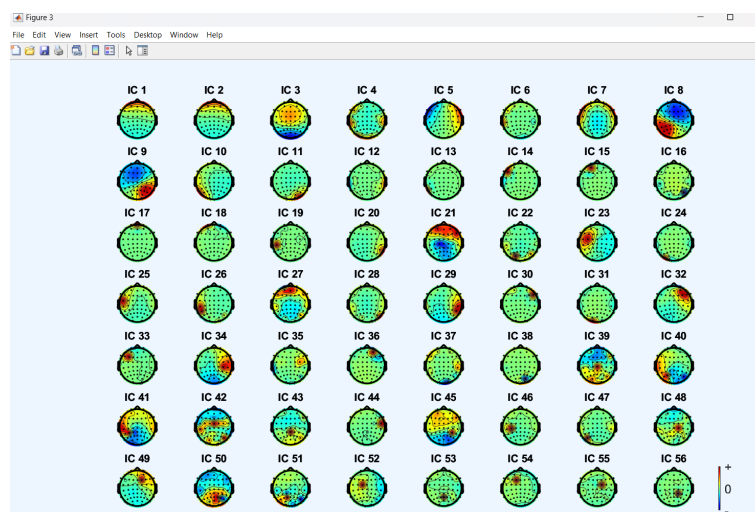## 3 Independent Component Analyses

3.1 Run ICA

Figure 5

3.2 Manual Check of the components

We mark the "bad" ones Reject Data **1, 5, 7, 9, 11, 16, 21, 29, 32, 43**
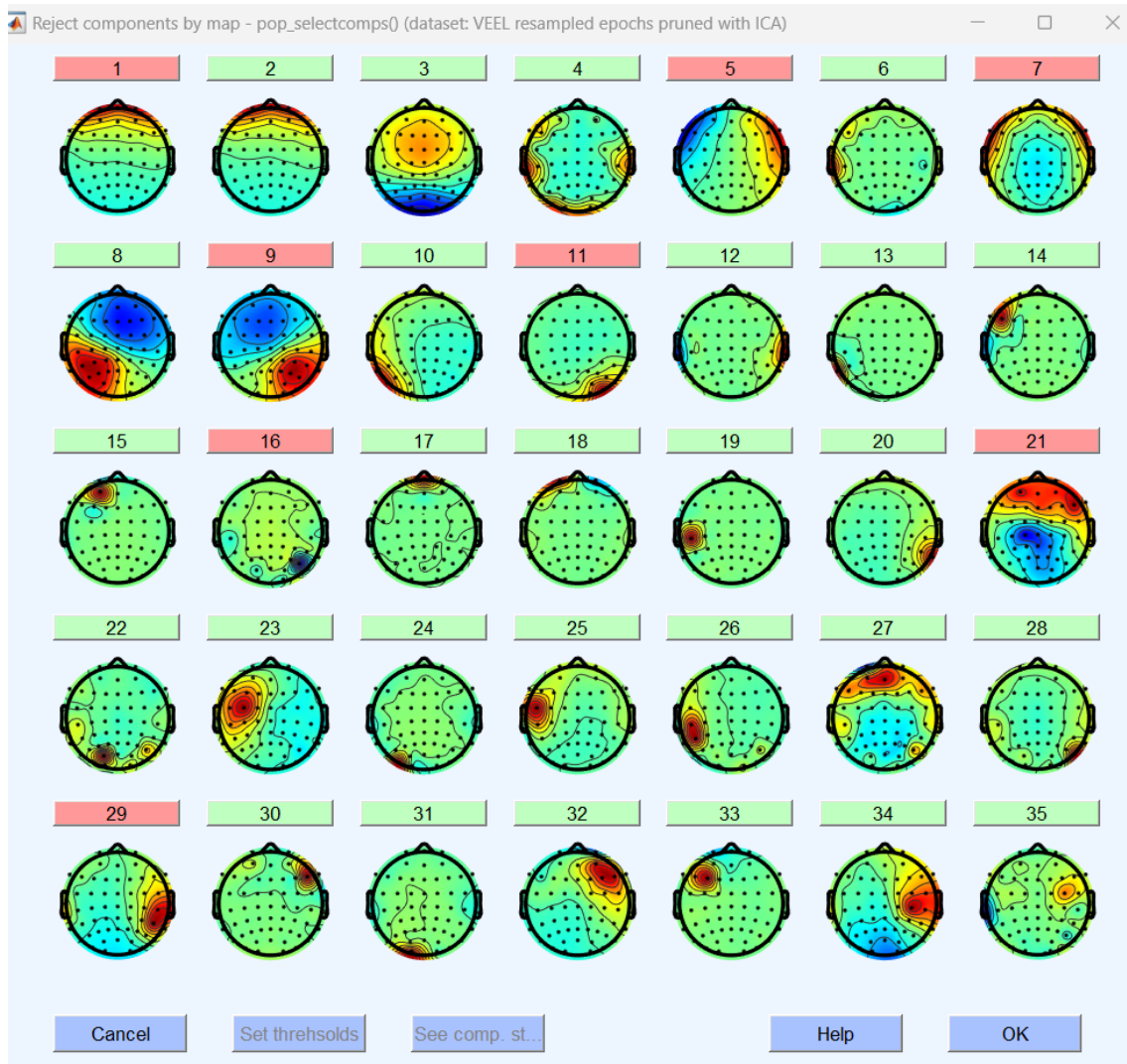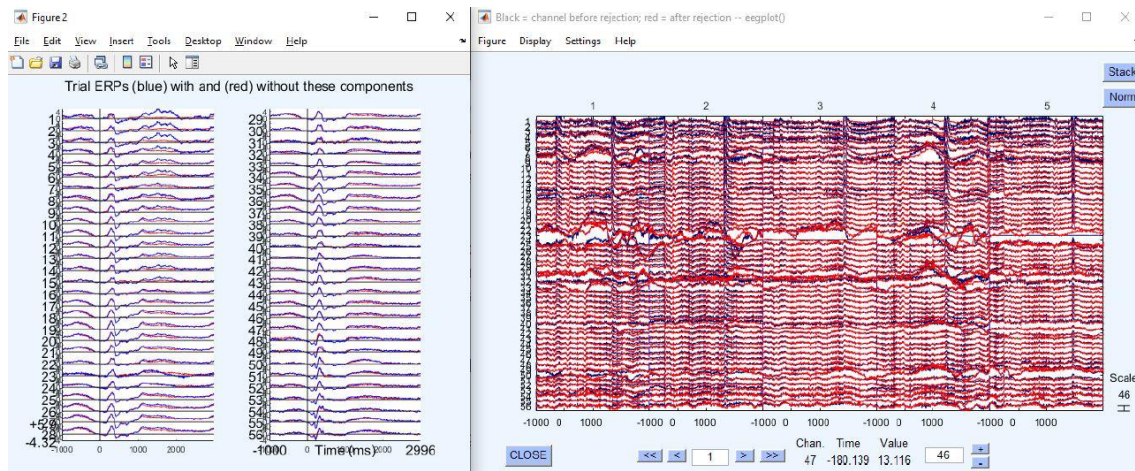

Figure 6

Figure 7

4 Channels Interpolation

If our electrode is noisy due to imperfect contact, it can increase the noise of other electrodes when we are using the commonly used average. So, that's why we interpolate. Although filtering can be a solution it's not an effective way of dealing with bad channels. Hence we interpolate the channels which means we get rid of the data from the bad channel and replace it with the data reconstructed from the surrounding electrodes. On the GUI select "Interpolate Electrodes" and "Use specific channels of other dataset"

5 On the "clean" dataset Perform Average Reference

6 Plot/Channels Spectra and Maps

Run the spectra on 100 percent of the data adding one scalp map for each physiological frequency range (delta 1-4Hz, theta 4-8Hz, alpha 8-13Hz, beta 15-25Hz)
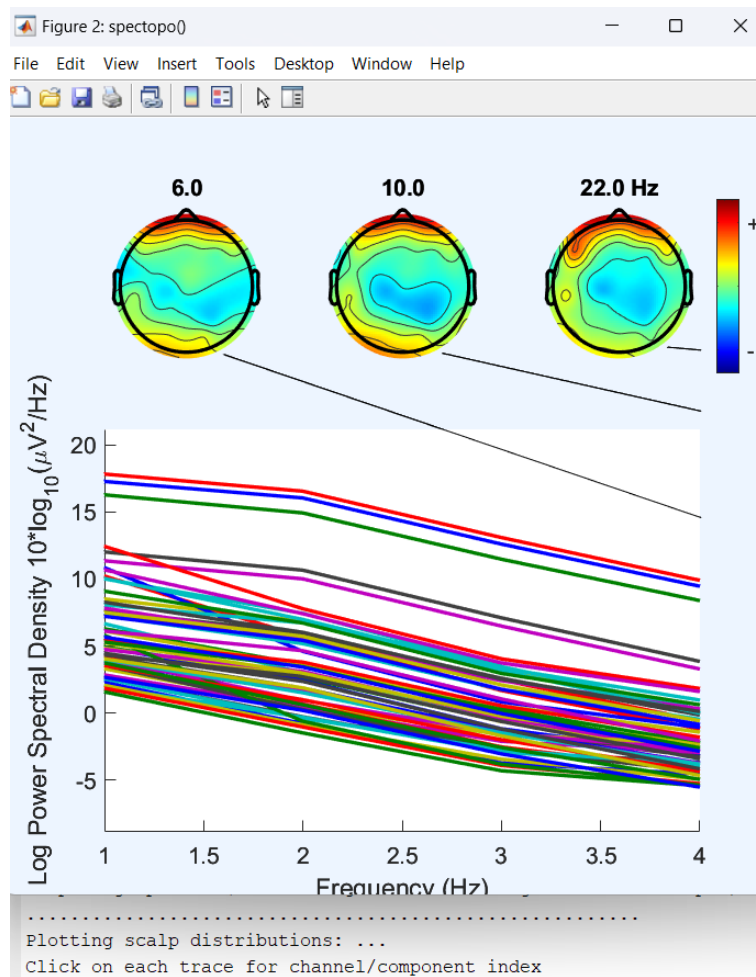
FREQUENCIES: *Delta: 1 – 4 Hz* : **sleep**

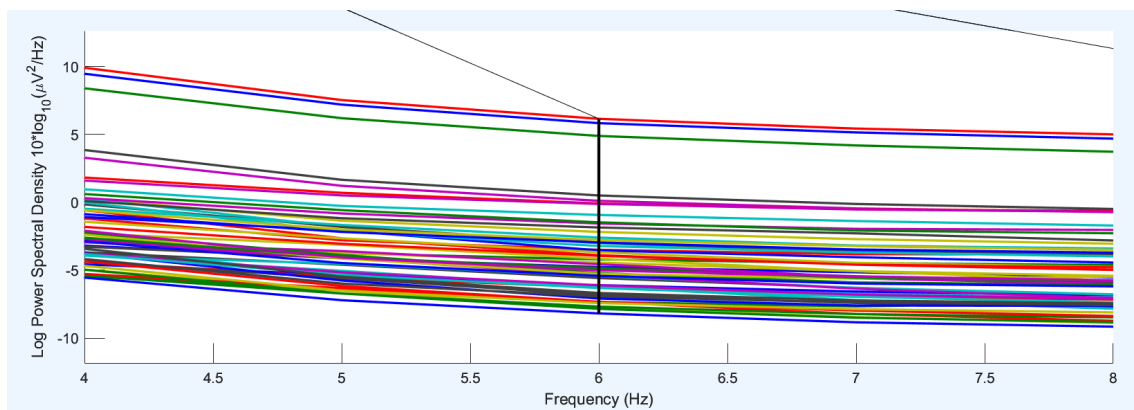**Figure 8**

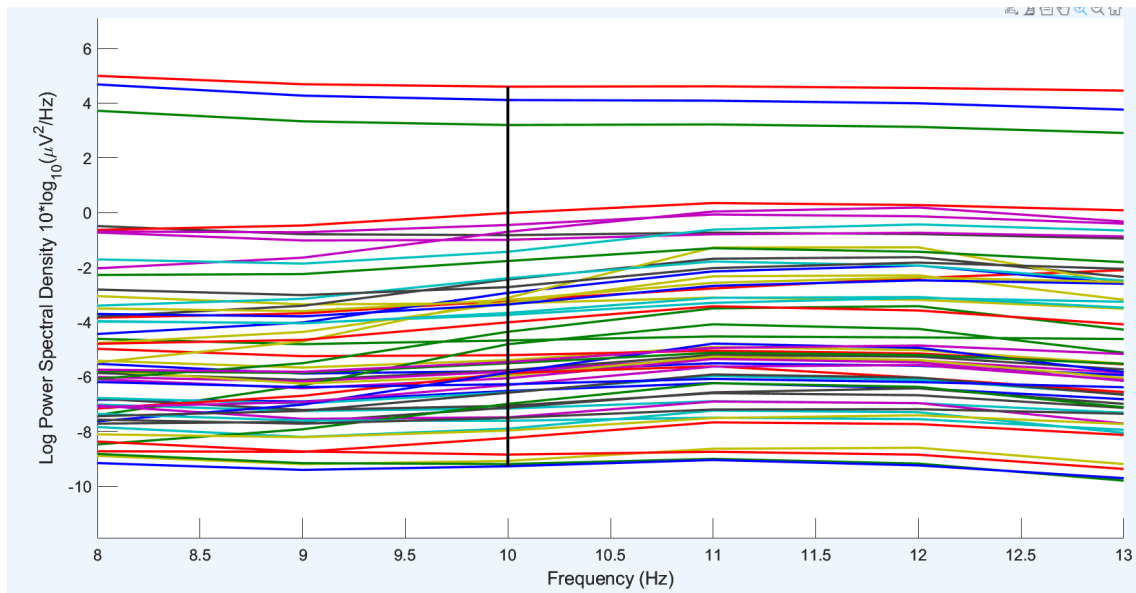*Theta: 4 – 8 Hz* : **attention**
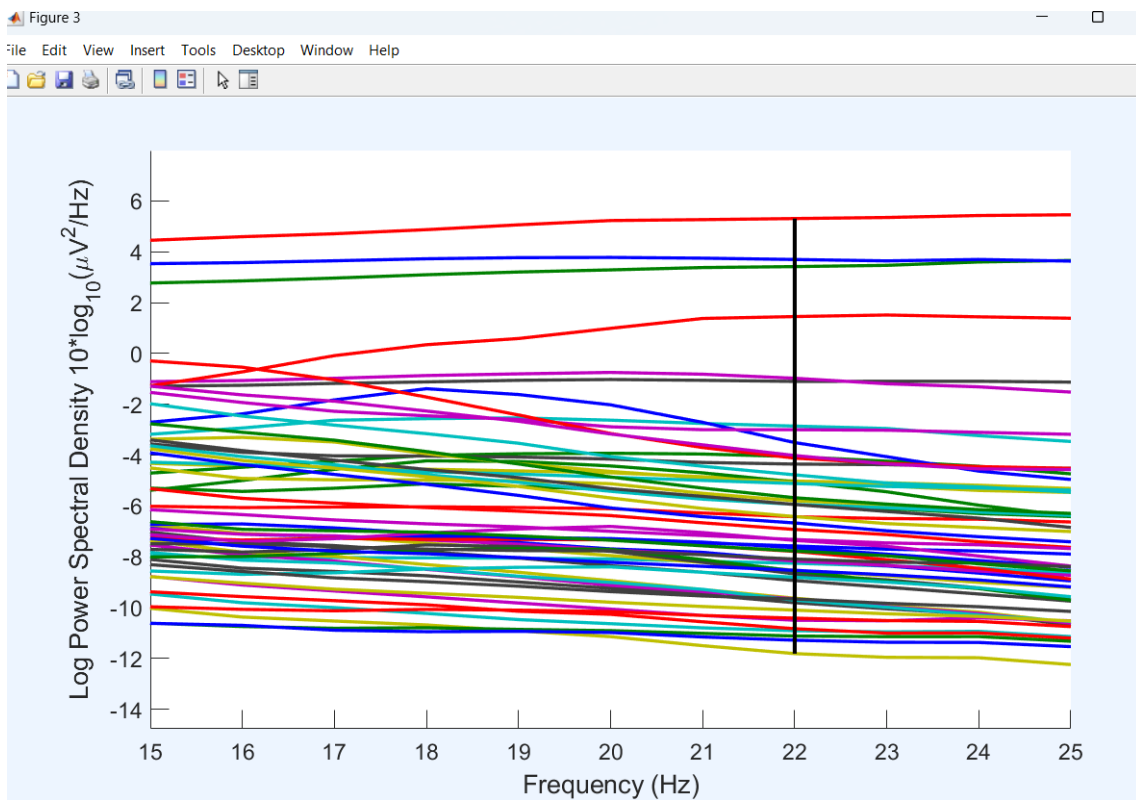

Figure 9

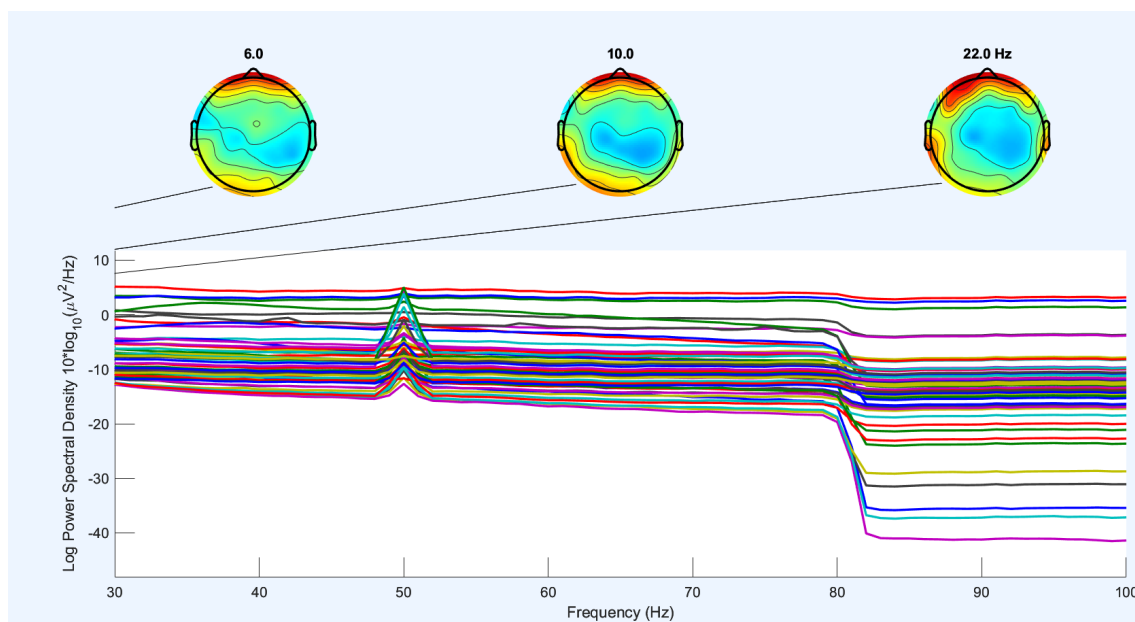*Alpha: 8 – 13 Hz* : **eyes closed**

Figure 10

Beta: 15 – 25 Hz : **movements**

Figure 11

All Together:

Figure 12

NOTE: Gamma waves, ranging from 30 to 100 Hz, play a role in enhancing cognitive abilities like memory and learning. They achieve this by coordinating neural activity among various regions of the brain. Furthermore, the presence of multiple peaks concentrated around 11Hz in the occipital area suggests activity associated with both relaxations with eyes closed and movement. These frequencies align with the alpha and beta ranges, respectively.