Report BSP Assignment

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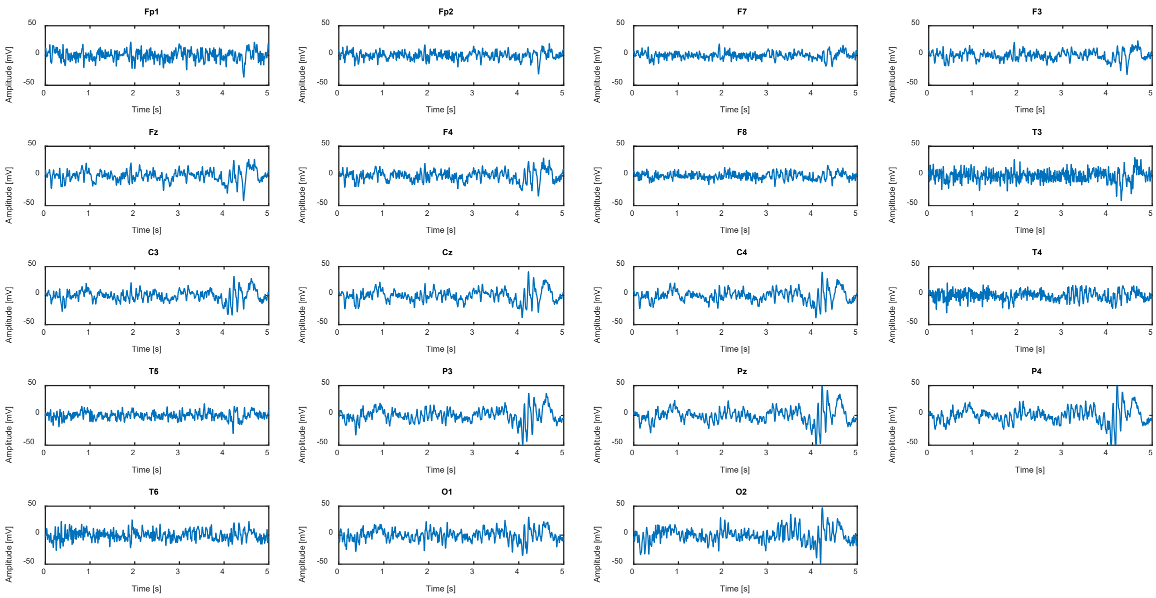
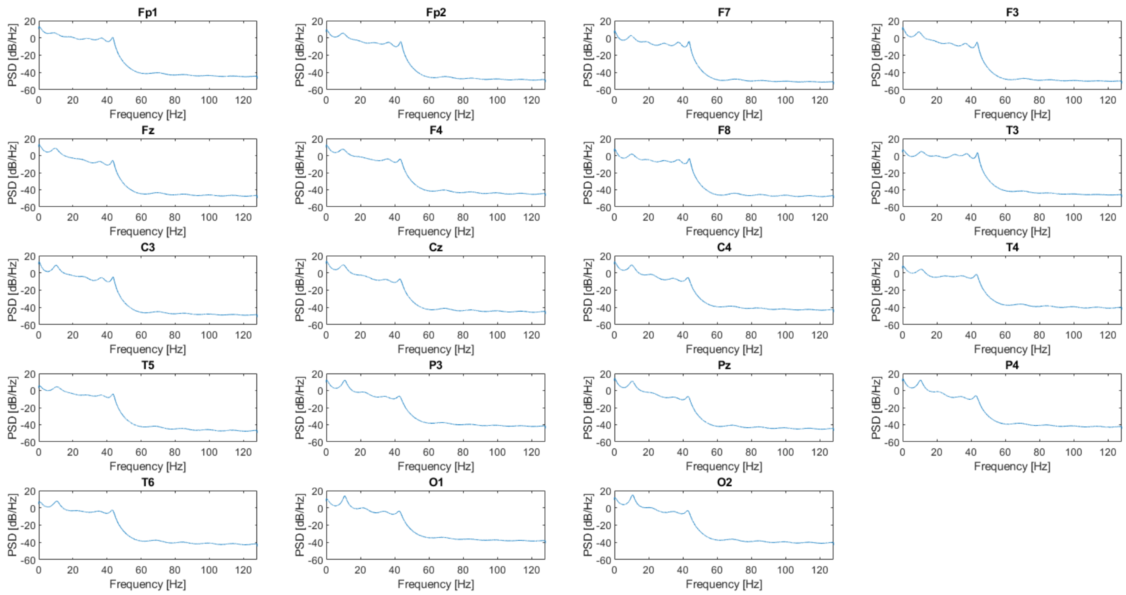
SECTION 1

First 5 seconds of the EEG data in the baseline condition. Y-axis limited between -50 and +50 mV for comparison.



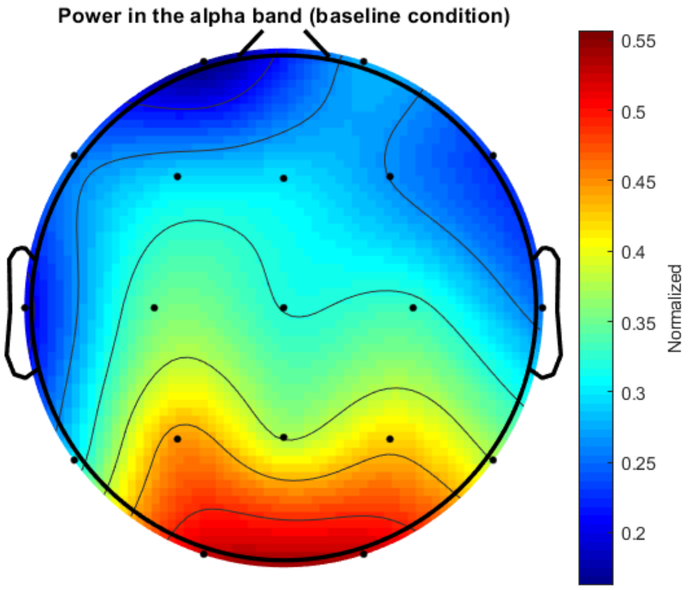
SECTION 2

Power Spectral Density (PSD) of the EEG data during baseline conditions. Y-axis limited between -60 and +20 dB for comparison.



SECTION 3

Normalized spectral power of each channel in the alpha band during baseline conditions.



SECTION 4

Plot the change in the alpha band (comparing baseline vs stimulation).

The power spectrum returned by the pyulear function is given using a linear scale, hence a subtraction of two normalized power spectrums will be equal to a new linear normalized power vector.

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% Compute the change in power within the alpha band
p_alpha_diff = p_alpha_b - p_alpha_s;
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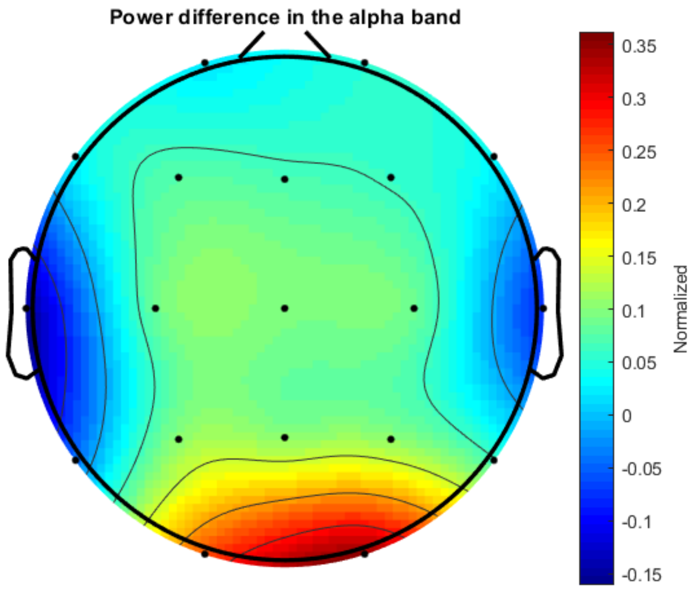
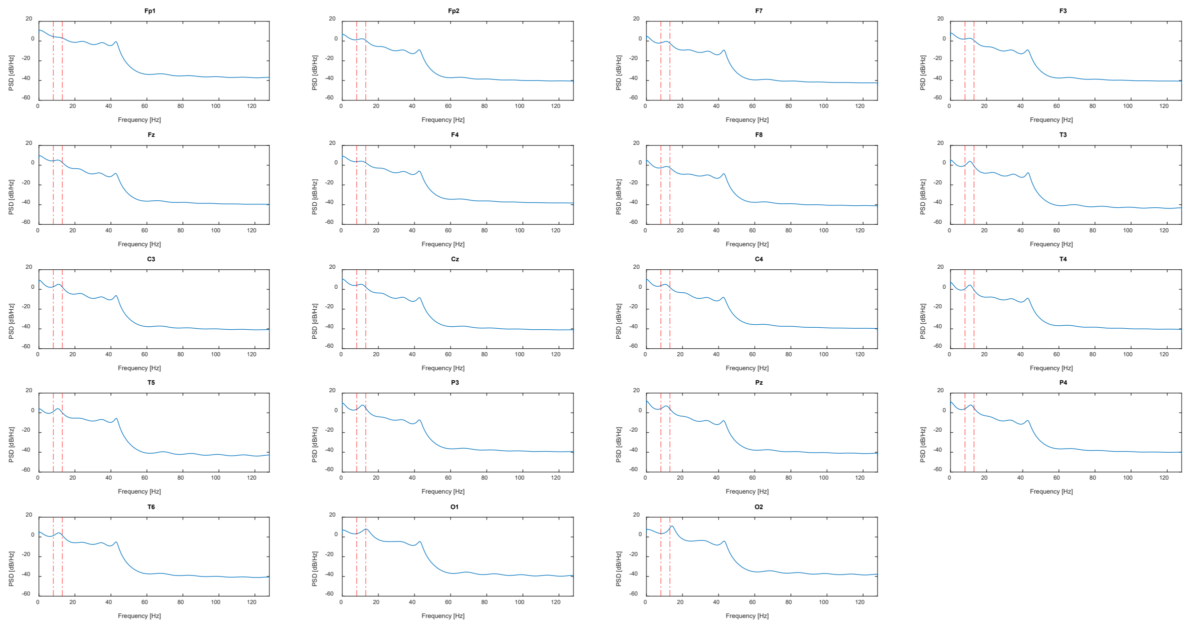
Result expressed using a linear scale:



SECTION 5

Power Spectral Density (PSD) of the EEG data during the stimulation condition. Red dashed lines depict the alpha-band region.



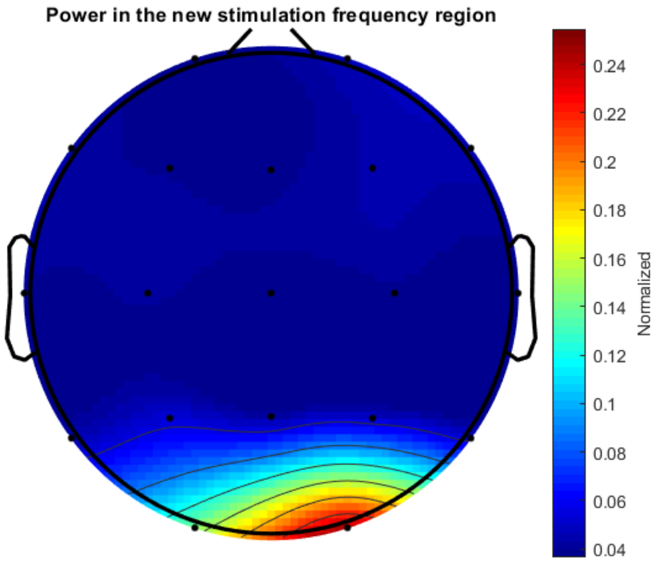
SECTION 6

Which is the most peculiar change in PSDs when comparing the baseline versus the stimulation condition?

To better identify the differences in frequency content, PSDs during baseline and stimulation condition are superimposed channel by channel. Comparing the two situations, it is possible to spot a clear difference in power in the occipital lobe, the visual processing center of the brain containing most of the anatomical region of the visual cortex: during the stimulation process the normalized power decreases while the peak frequency increases. This is confirmed as the subject goes from a resting situation where alpha waves are predominant to a condition where he undergoes repeated visual stimuli that tend to suppress the alpha waves.

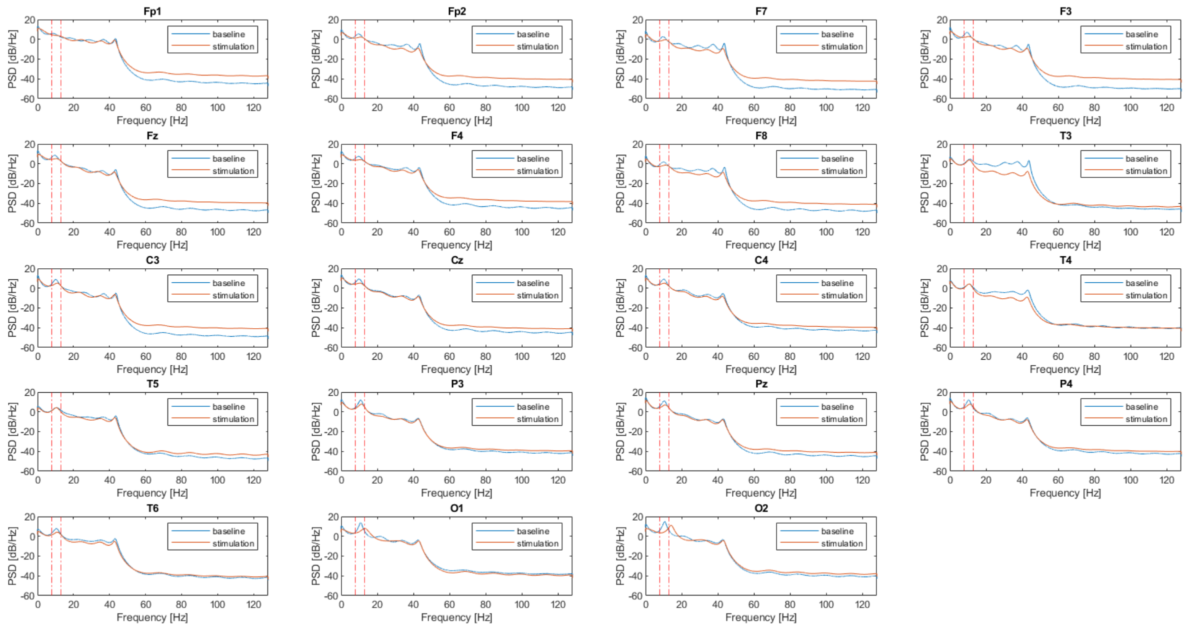
SECTION 7

Spectral power in the interval [new frequency $\pm$1Hz] for each channel. New frequency set to 14.1Hz.



SECTION 8

Comparison between the PSD generated during baseline and stimulation conditions:



According to the topoplot obtained in section 7, it is shown that the electrodes O1 and O2 registered the highest power spectra magnitudes associated to the frequency around 14.18 Hz. As reported in (1), the visual cortex is located in the back of the brain, Brodmann area 17 (2), exactly the area where these two electrodes are located, in accordance, the results are in line with these theoretical considerations. Furthermore, the PSD graphs in section 6 depict a high magnitude associated to the frequency centered at 14.18 Hz which, according to the stimulation paradigm (15 Hz), are nearly the same, which is the expected behavior as reported in (3)(4). The alpha power variation between the baseline and the stimulation conditions is expected to decrease since the patient goes from a stress free condition where the alpha rhythm predominates, to an active one where higher frequency activity should be registered (5).

REFERENCES

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3. Seiji Nishifuji, Kentaro Fujisaki, Shogo Tanaka. Effects of light stimulus frequency on phase characteristics of brain waves. SICE Annual Conference 2007 [Internet]. IEEE; 2007 [cited 2019 May 16]. p. 2743–9. Available from: http://ieeexplore.ieee.org/document/4421455/

4. Srinivasan R, Bibi FA, Nunez PL. Steady-state visual evoked potentials: distributed local sources and wave-like dynamics are sensitive to flicker frequency. Brain Topogr [Internet]. NIH Public Access; 2006 [cited 2019 May 16];18(3):167–87. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16544207

5. Saeid S, Chambers JA. Introduction to EEG. EEG Signal Processing. John Wiley & Sons; 2007. p. 1–34.