

SVKM's NMIMS
Mukesh Patel School of Technology Management & Engineering
Computer Engineering Department
Program: B. Tech/MBA Tech EXTC

Course: B. Tech/MBA. Tech (EXTC)

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<i>Batch:</i>	<i>Date of Experiment:</i> 13-01-2022
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AIM: -Feature extraction of EEG Signals

Frequency domain feature: Apply the FFT transform and extract the spectral features

Delta: 0.5 to 4Hz

Theta 4 to 8 Hz

Alpha 8 to 16 Hz

Beta 16 to 32 Hz

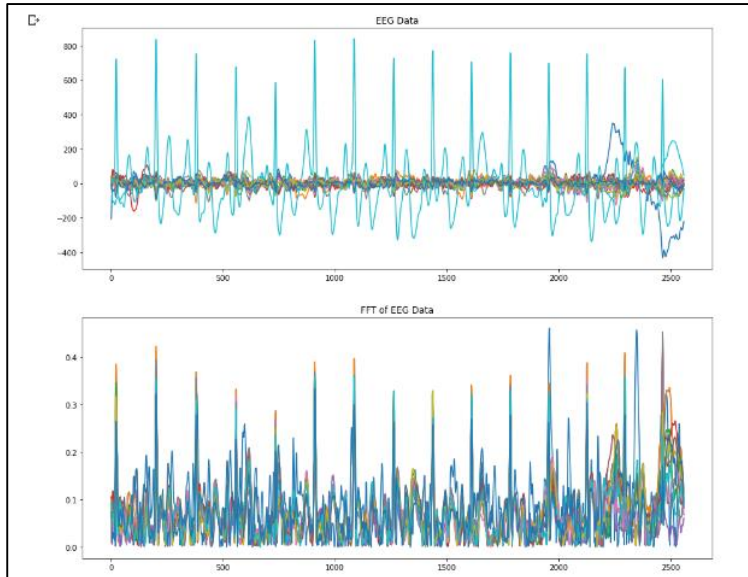
Gamma 32 to 99 Hz

Colab Link: https://colab.research.google.com/drive/1OTJ0eKA92P9_SpA6lBqOnhza3SSk-a-N?usp=sharing

Instructions and Objective:

1. Open the data base of Neuromax Select any subjects between 3-9
2. Set the gain 30 μ V/mm, page speed 30 mm/sec, lower freq. 0.5 and higher 99 Hz enable the notch filter 50 HZ and Mont 3
3. Export the data from in excel for 10 secs, samples 2560 (both filtered and unfiltered)
4. Import the CSVs in google collab
5. Remove NaN values if any from the data
6. Perform FFT analysis (for both dataset)
 - a. Plot the graphs of statistical feature for both filtered and unfiltered data
 - b. Plot the spectral graphs representing magnitude and frequency bands

Output



After importing the data and extracting all the EEG data we get this as the output of all egg data combined. After plotting the Egg data, we take the fft of that wave and plot it.

Figure-1: EEG Data

Figure-2: FFT of EEG Data

I then extracted all the EEG data in the data.txt file

Delta

Absolute delta power: 321.064 μV^2

```
✓ 35 ▶ # Relative delta power (expressed as a percentage of total power)
total_power =.simps(psd, dx=freq_res)
delta_rel_power = delta_power / total_power
print('Relative delta power: %.3f' % delta_rel_power)
```

📄 Relative delta power: 0.787

📄 Delta/beta ratio (absolute): 42.214
Delta/beta ratio (relative): 42.214

Alpha

📄 Absolute alpha power: 19.934 μV^2

```
[71] # Relative delta power (expressed as a percentage of total power)
total_power =.simps(psd, dx=freq_res)
alpha_rel_power = alpha_power / total_power
print('Relative alpha power: %.3f' % alpha_rel_power)
```

Relative alpha power: 0.049

Delta/alpha ratio (absolute): 16.106
Delta/alpha ratio (relative): 16.106

Theta

Absolute theta power: 33.501 μV^2

```
[78] # Relative delta power (expressed as a percentage of total power)
total_power =.simps(psd, dx=freq_res)
theta_rel_power = theta_power / total_power
print('Relative theta power: %.3f' % theta_rel_power)
```

Relative theta power: 0.082

Delta/theta ratio (absolute): 9.584
Delta/theta ratio (relative): 9.584

Gamma

Absolute gamma power: 0.093 uV²

✓ [86] gamma_power

0.09309551820817291

✓ [86] total_power

407.9836247396255

✓ [92] gamma_rel_power = gamma_power/total_power
print(gamma_rel_power)

0.00022818444800961393

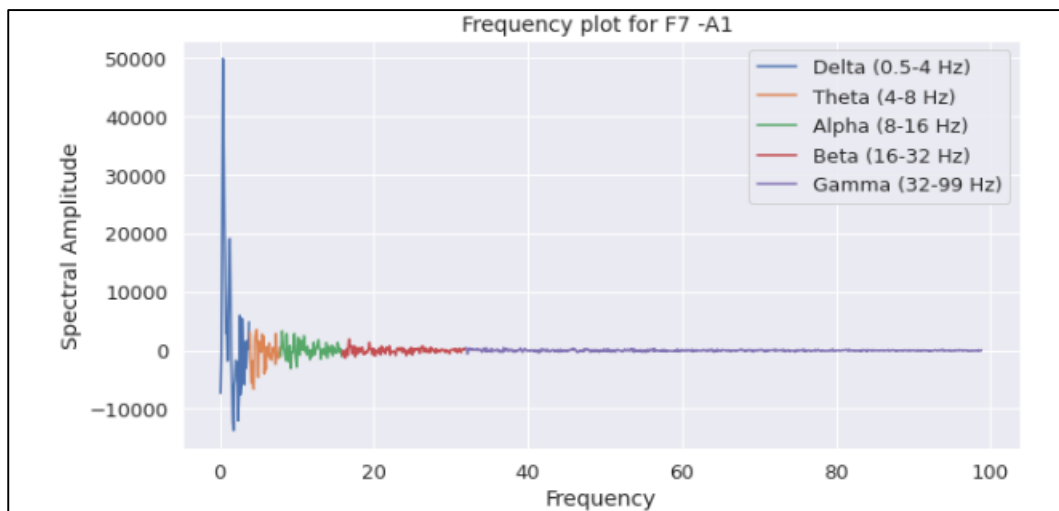
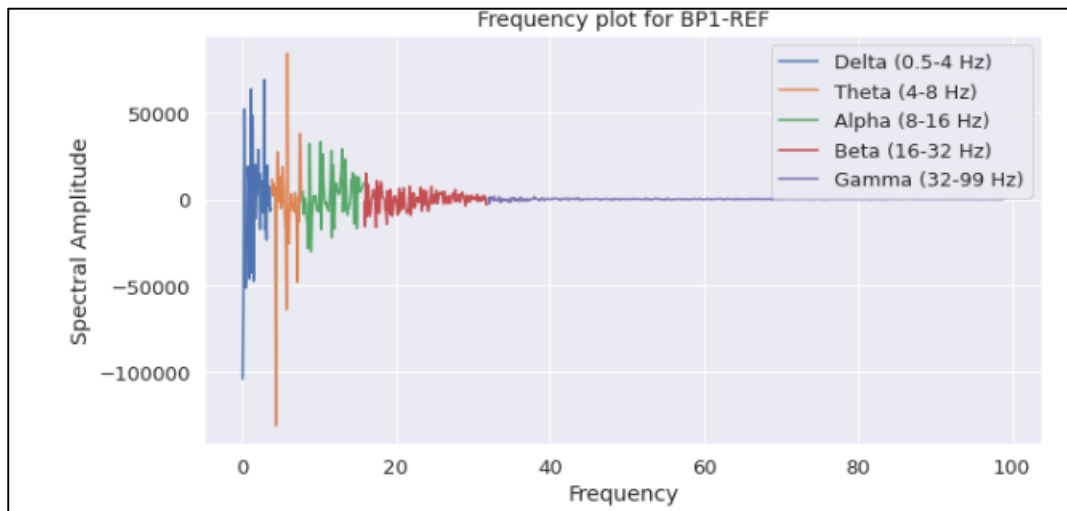
Delta/gamma ratio (absolute): 3448.760
Delta/gamma ratio (relative): 3448.760

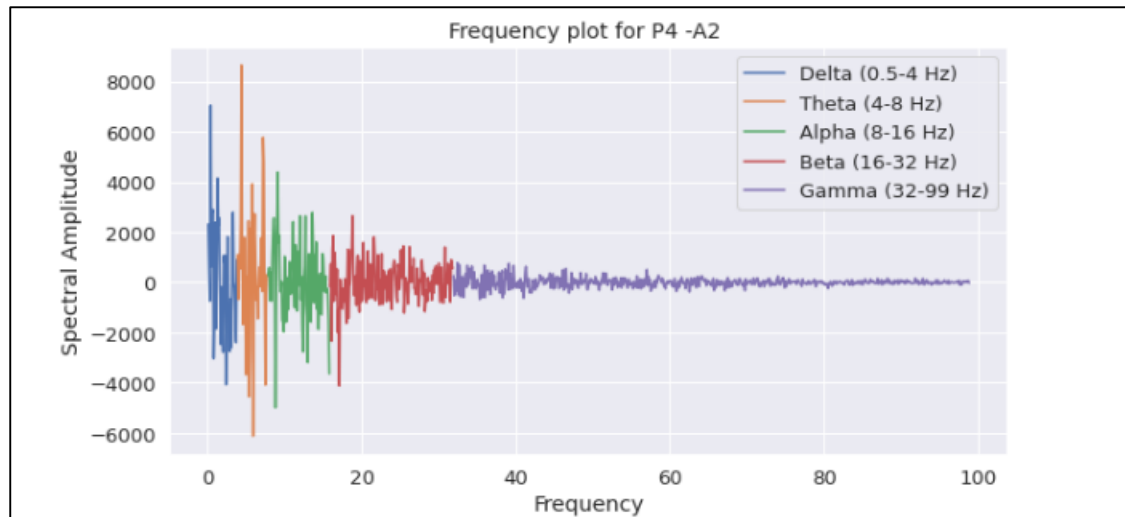
Combination of all results

	Parameter	Value
0	Absolute gamma power uV ²	0.093000
1	Relative Gamma Power	0.000228
2	Delta/gamma ratio	3448.760000
3	Absolute theta power uV ²	33.501000
4	Relative theta Power	0.082000
5	Delta/theta ratio	9.584000
6	Absolute alpha power uV ²	19.934000
7	Relative alpha Power	0.049000
8	Delta/alpha ratio	16.106000
9	Absolute delta power uV ²	321.064000
10	Relative delta Power	0.787000
11	Delta/beta ratio	41.225000

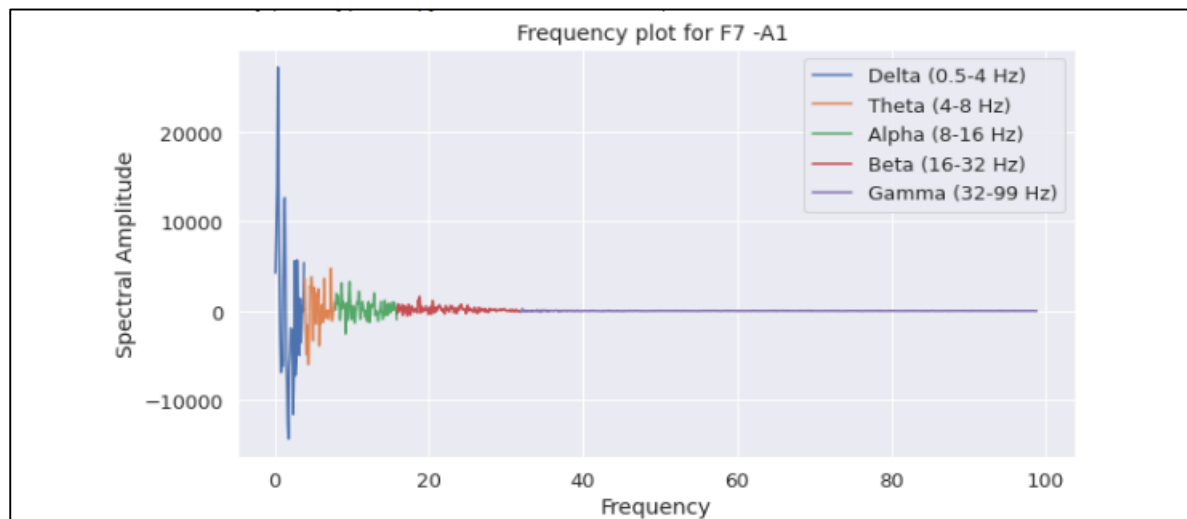
Plots

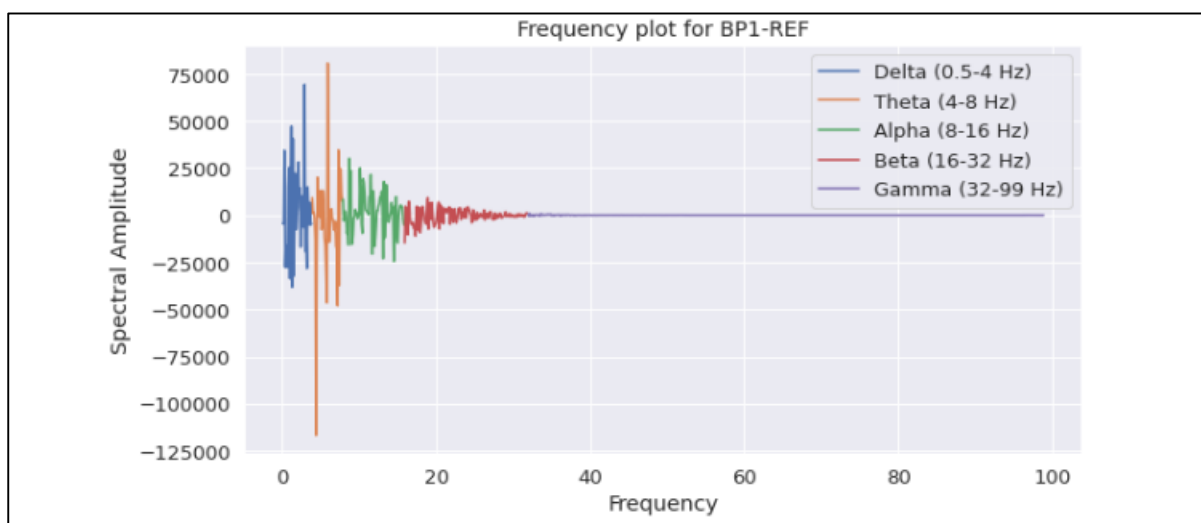
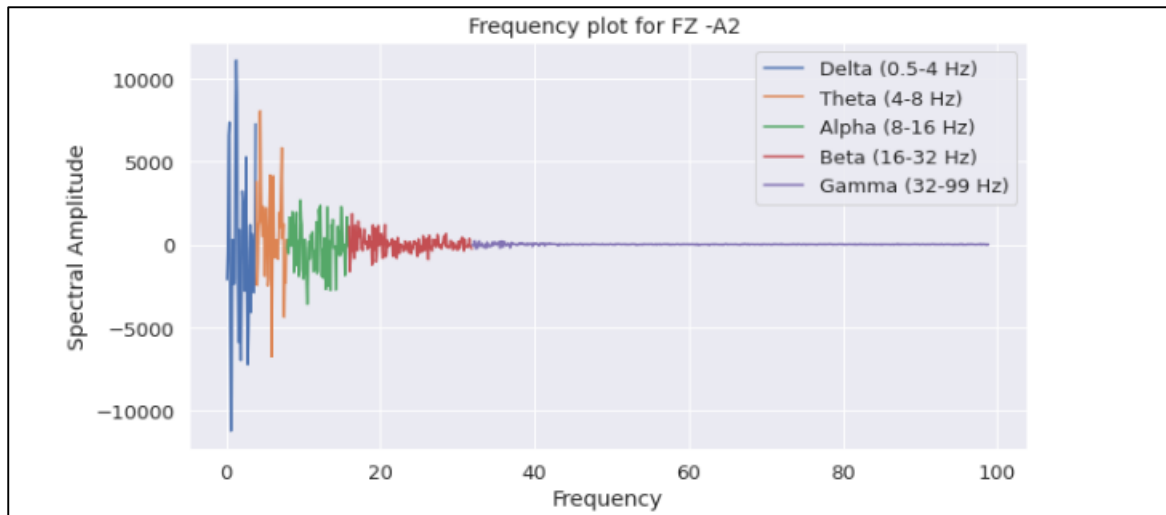
Filtered





Unfiltered





Conclusion:

From this experiment we extracted the eeg data from the dataset and applied the fast Fourier transform on the eeg signals after that extract the spectral features

- Delta: 0.5 to 4Hz [Drowsy state]
- Theta 4 to 8 Hz [Alert state]
- Alpha 8 to 16 Hz [Meditative state]
- Beta 16 to 32 Hz [Drowsy state]
- Gamma 32 to 99 Hz [High alert level state]