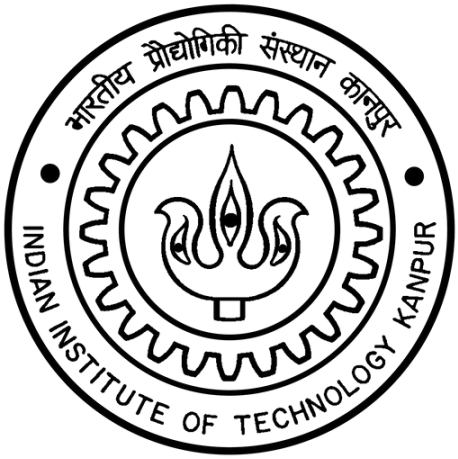


CGS641A

INSTRUCTOR

Dr. Pragathi Balasubramanian

TOPIC

SLEEP RELATED NEURAL DISORDER- SLEEP APNEA AND ITS RELATION WITH DIFFERENT TYPES OF BRAIN WAVES

1.INTRODUCTION

Sleep apnea is a neurological disease which affects millions world wide.During my research I first discover the basic signs and the nature of sleep apnea and how is it different from other disablities.

In the second half I will be looking at the more technical side of it including observation of its EEG data.

In the last section I will be concluding the research on how can we lower its effects on the affected.

1.1 Sleep Apnea

Sleep apnea is a potentially serious sleep disorder in which breathing repeatedly stops and starts. If you snore loudly and feel tired even after a full night's sleep, you might have sleep apnea.

Sleep apnea happens when upper airway muscles relax during sleep and pinch off the airway, which prevents you from getting enough air. Your breathing may pause for 10 seconds or more at a time, until your reflexes kick in and you start breathing again

There are two types of sleep apnea-OSA and CSA

Obstructive sleep apnea happens when air can't flow into or out of the nose or mouth, although you're trying to breathe.

Central sleep apnea happens when the brain fails to send the right signals to your muscles to make you start breathing. (This type is less common.)
We will be relating OSA(obstructive sleep apnea) in this study because CSA is very uncommon in population.

Its scale-Sleep apnea occurs in about 3 percent of normal weight individuals but affects over 20 percent of obese people.

https://www.hopkinsmedicine.org/health/wellness-and-prevention/the-dangers-of-uncontrolled-sleep-apnea#:~:text=There%20are%20two%20kinds%20of,apnea%20and%20central%20sleep%20apne

So isn't Sleep apnea , just snoring?

Snoring is just the vibration sound created by airway resistance. You can snore loudly and not have sleep apnea, and you may even have sleep apnea without much snoring. The most common symptoms of obstructive and central sleep apneas include:

- Loud snoring.
- Episodes in which you stop breathing during sleep — which would be reported by another person.
- Gasping for air during sleep.
- Awakening with a dry mouth.
- Morning headache.
- Difficulty staying asleep, known as insomnia.
- Excessive daytime sleepiness, known as hypersomnia.
- Difficulty paying attention while awake.
- Irritability.

https://www.mayoclinic.org/diseases-conditions/sleep-apnea/symptoms-causes/syc-20377631#:~:text=Sleep%20apnea%20is%20a%20potentially,you%20might%20have%20sleep%20apnea.

STOP		
Do you SNORE loudly (louder than talking or loud enough to be heard through closed doors)?	Yes	No
Do you often feel TIRED, fatigued, or sleepy during daytime?	Yes	No
Has anyone OBSERVED you stop breathing during your sleep?	Yes	No
Do you have or are you being treated for high blood PRESSURE?	Yes	No

BANG		
BMI more than 35kg/m2?	Yes	No
AGE over 50 years old?	Yes	No
NECK circumference > 16 inches (40cm)?	Yes	No
GENDER: Male?	Yes	No

TOTAL SCORE		

High risk of OSA: Yes 5 - 8

Intermediate risk of OSA: Yes 3 - 4

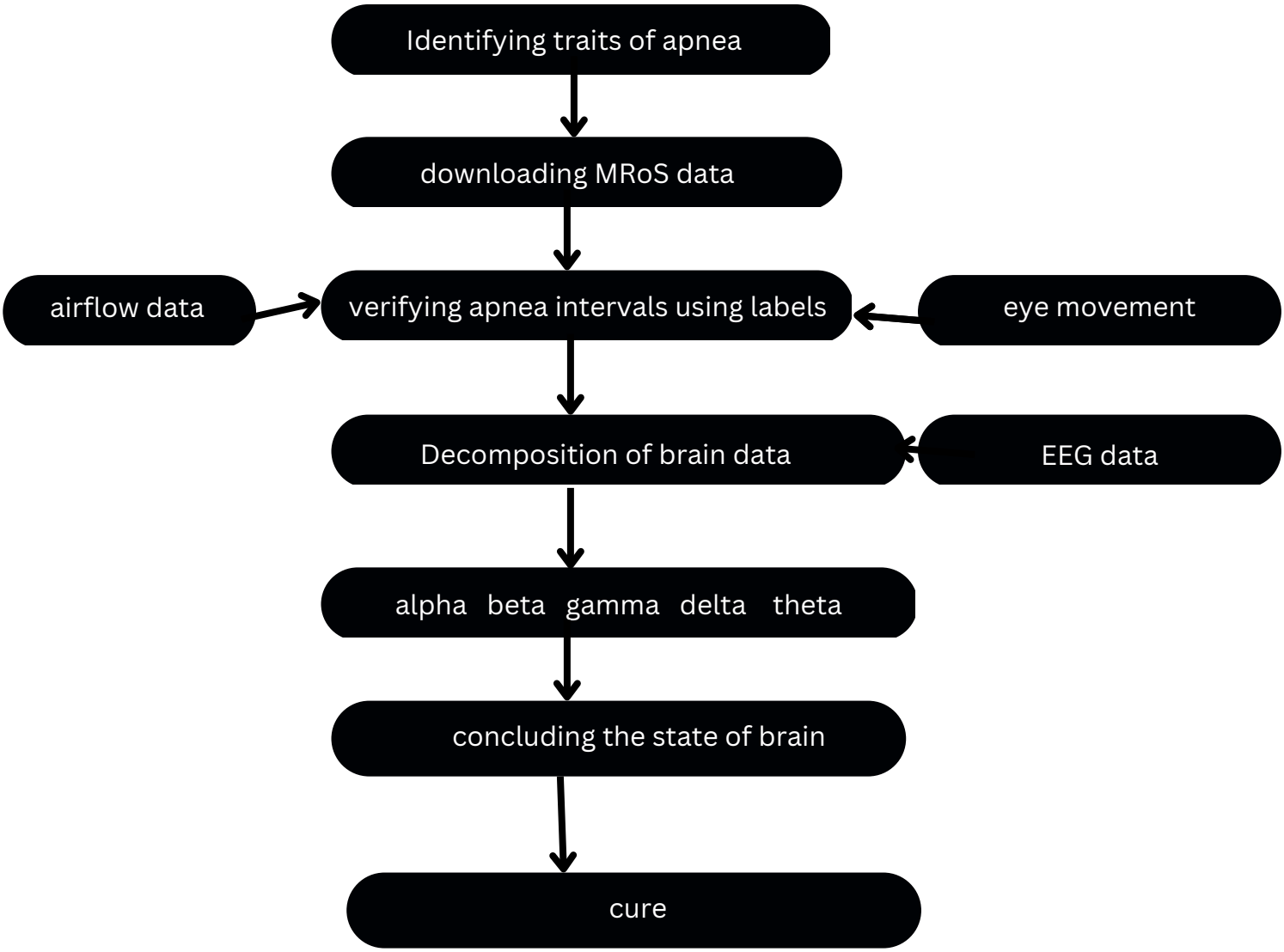
Low risk of OSA: Yes 0 - 2

questionaire-
https://www.google.com/url?sa=i&url=https%3A%2F%2Fgpnotebook.com%2Fsimplepage.cfm%3FID%3Dx20190721193924949909&psig=AOvVaw2ZY_RN5Q5xWOE6hGyLswat&ust=1677649078989000&source=images&cd=vfe&ved=0CBEQjhxqFwoTCJi57vy_t_0CFQAAAAAdAAAAABAb

2.Research Methodology

Sleep apnea can be identified with the airflow data.Also I will verify the point - Sleep apnea can be identified with the surge in arousal during sleep.Which i will do by analysing the airflow data.Also I will use the psg data to identify the brain waves during the intervals of apnea.

2.0 Road map



2.1 Downloading MRoS dataset

Software NSRR gem
Ruby

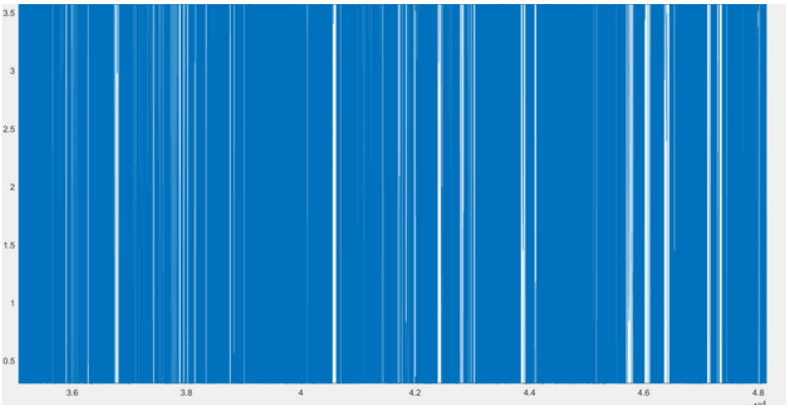
2.2 Airflow

Software-Matlab
Reason-Airflow is the basis of identification of Apnea.

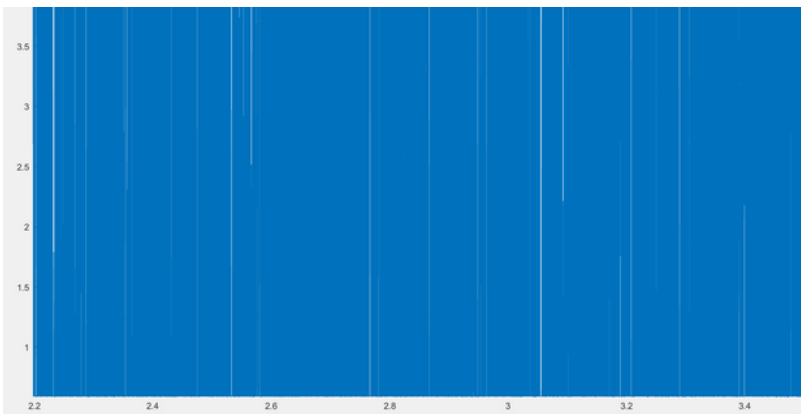
Labels were provided in my data set although verifying it would more solidify the results.

I have data set of airflow measured at 16 hz ,over 16x60 data points in a minute ,I averaged it to get an average in a minute .512 minutes of overall recording is available.

If it is intake i.e value >0 then assigning it a label of 1 otherwise 0.So 0 is exhale or no air exchange .



airflow data during apnea



airflow data during no apnea

2.2.1 Airflow conclusion

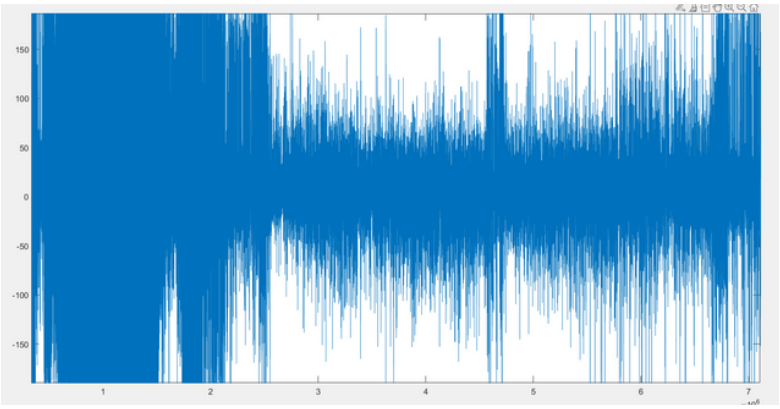
Airflow data matches with labels during sleep apnea which confirms that labels are true and there are large gaps of no air intake during the interval.

2.2.2 Airflow data plot code

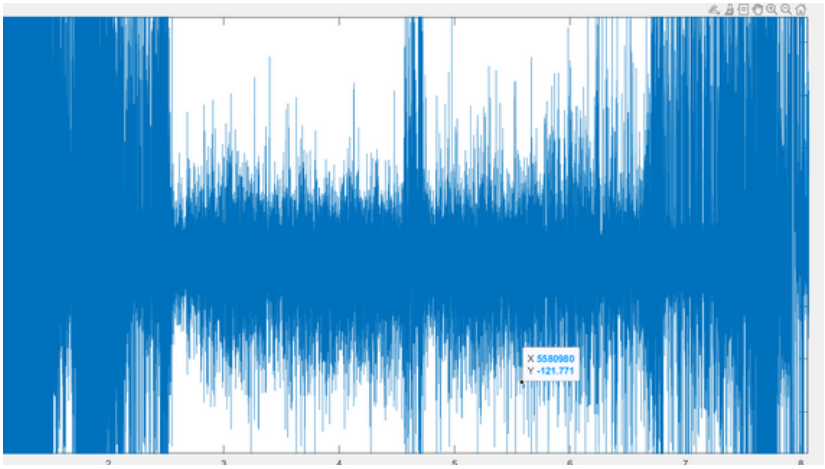
```
clear all
close all
clc

%% Load xml file

pro_xml = readstruct("mros-visit1-aa0169-profusion.xml");

%% Load data is needed
data = edfread("mros-visit1-aa0169.edf");
sampdata = cell2mat(data.Airflow);

num_blocks = floor(length(sampdata) / 16);
averaged_data = zeros(num_blocks, 1);

for i = 1:num_blocks
 block_start = (i - 1) * 16 + 1;
 block_end = i * 16;
 averaged_data(i) = mean(sampdata(block_start:block_end));
end
plot(1:num_blocks, averaged_data);
xlabel('Block number');
ylabel('Average value');
title('Averaged Data from 32000 Data Set');
```

2.3 Eye Movement

Software-Matlab
Reason-To verify whether there are awake points during the given labels of apnea



Right eye movement



Left eye movement

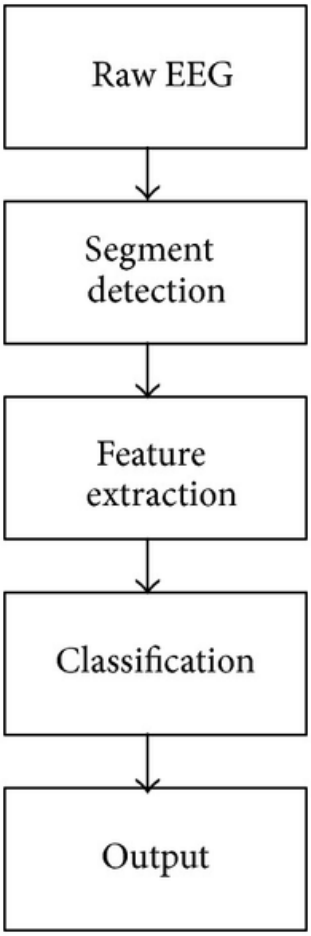
2.3.1 EYE movement conclusion

Airflow data matches with labels during sleep apnea which confirms that labels are true and there are large gaps of no air intake during the interval.

3.0 EEG data

From A1,A2,C3,C4 labeling the delta alpha beta gamma delta waves.I have data set of EEG at 256hz.

3.1 Stages of EEG data processing

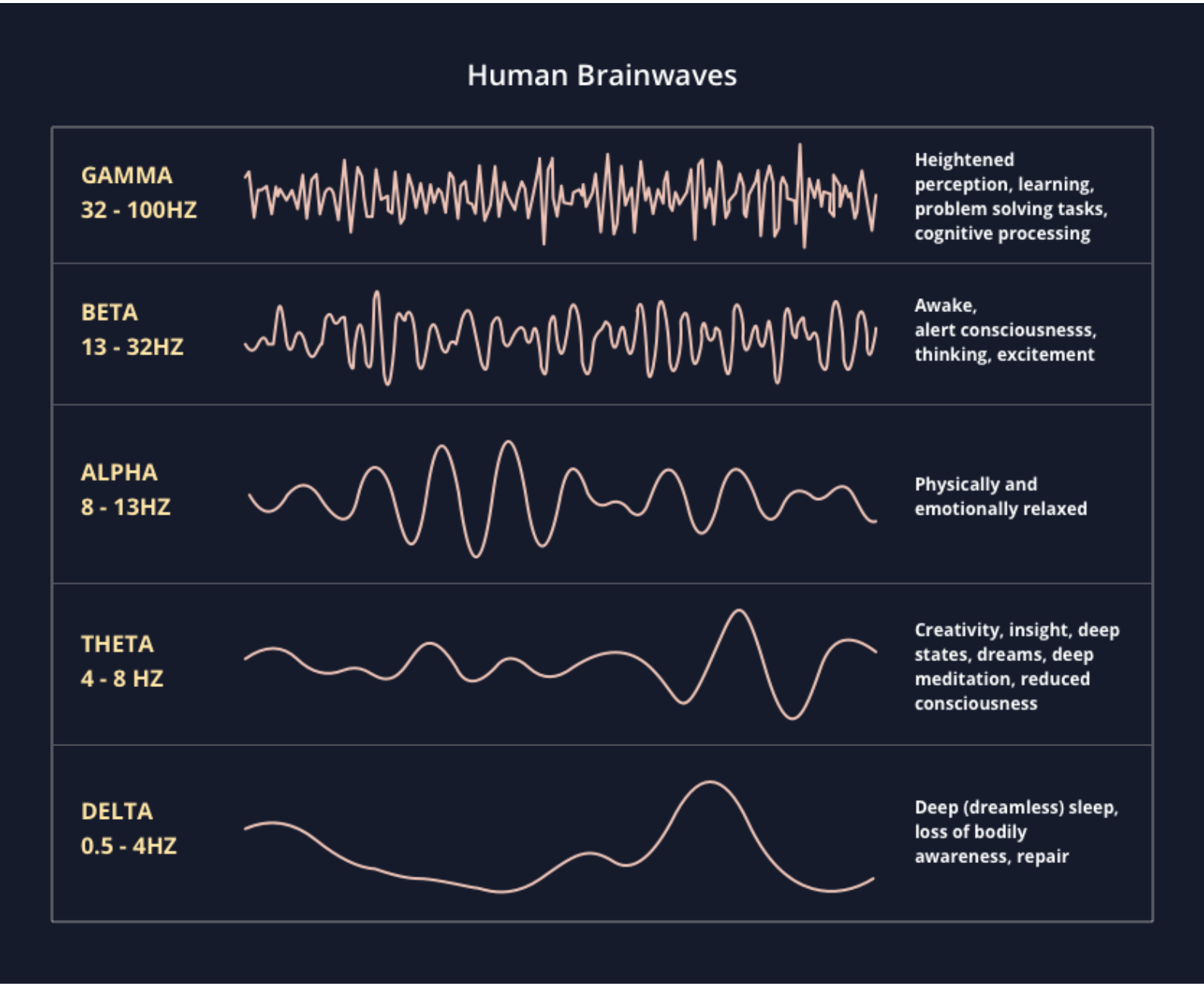


```
clear all
close all
clc

%% Load xml file

pro_xml = readstruct("mros-visit1-aa0169-profusion.xml");

%% Load data is needed
data = edfread("mros-visit1-aa0169.edf");
% Load the EEG data
load('brain_data.mat'); % replace with your own data file name

% Define the sampling rate
Fs = 256; % Hz

 delta_band = [0.5 4]; % Hz
theta_band = [4 8]; % Hz
alpha_band = [8 13]; % Hz
beta_band = [13 32]; % Hz
gamma_band = [32 100]; % Hz

A1_channel = 1; % A1
A2_channel = 2; % A2
C3_channel = 3; % C3
C4_channel = 4; % C4


delta_eeg = bandpass(eeg_data(:, A1_channel), delta_band, Fs);
theta_eeg = bandpass(eeg_data(:, A1_channel), theta_band, Fs);
alpha_eeg = bandpass(eeg_data(:, A1_channel), alpha_band, Fs);
beta_eeg = bandpass(eeg_data(:, A1_channel), beta_band, Fs);
gamma_eeg = bandpass(eeg_data(:, A1_channel), gamma_band, Fs);

% power spectral density
delta_power = bandpower(delta_eeg, Fs, delta_band);
theta_power = bandpower(theta_eeg, Fs, theta_band);
alpha_power = bandpower(alpha_eeg, Fs, alpha_band);
beta_power = bandpower(beta_eeg, Fs, beta_band);
gamma_power = bandpower(gamma_eeg, Fs, gamma_band);

% Combine the features for all channels into a single vector
features = [delta_power, theta_power, alpha_power, beta_power, gamma_power];

% Display the extracted features
disp(features);
```

3.2 EEG comparing data

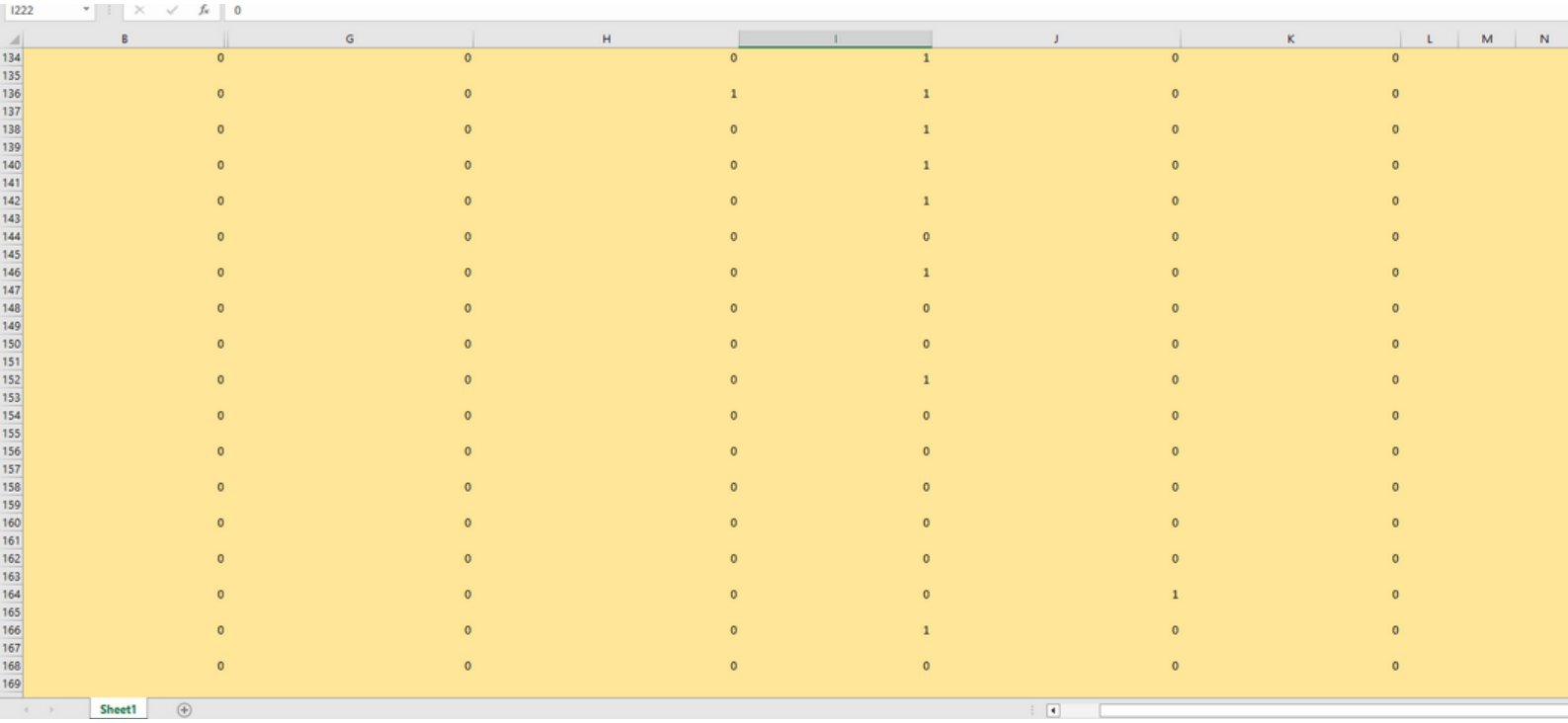
1.Averaging the individual wave power in a minute
2.output-the wave having the largest averaged power density in a minute and denoting it with a sign 1.

```
num_blocks = floor(length(sampdata) / 1000);
averaged_data = zeros(num_blocks, 1);

for i = 1:num_blocks
 block_start = (i - 1) * 15360 + 1;
 block_end = i * 15360;
 averaged_data(i) = mean(sampdata(block_start:block_end));
```



4.0 Results

putting everything on an excel sheet for easy viewing



	B	G	H	I	J	K
134	0	0	0	1	0	0
135						
136	0	0	1	1	0	0
137						
138	0	0	0	1	0	0
139						
140	0	0	0	1	0	0
141						
142	0	0	0	1	0	0
143						
144	0	0	0	0	0	0
145						
146	0	0	0	1	0	0
147						
148	0	0	0	0	0	0
149						
150	0	0	0	0	0	0
151						
152	0	0	0	1	0	0
153						
154	0	0	0	0	0	0
155						
156	0	0	0	0	0	0
157						
158	0	0	0	0	0	0
159						
160	0	0	0	0	0	0
161						
162	0	0	0	0	0	0
163						
164	0	0	0	0	1	0
165						
166	0	0	0	1	0	0
167						
168	0	0	0	0	0	0
169						

B-airflow
G-delta
H-alpha
I-beta
J-gamma
K-theta

4.1 Observation

from 66 minute to 110 minute -it is observed that it is an episode of apnea where airflow data signifies it by 0.
The brain waves prevalent were beta and partially deta.

beta is highest in 21 discrete minutes with 5 minutes continuously.We also see that beta was increasing in the minutes before the episode.

delta is highest in 7 discrete minutes with 2 minutes continuously.

alpha is seen in only 2-3 minutes

https://docs.google.com/spreadsheets/d/1DZbxgaJrLVjv4taq8odLMyQHkTPG4Brm/edit?usp=share_link&ouid=108788569667572353541&rtpof=true&sd=true

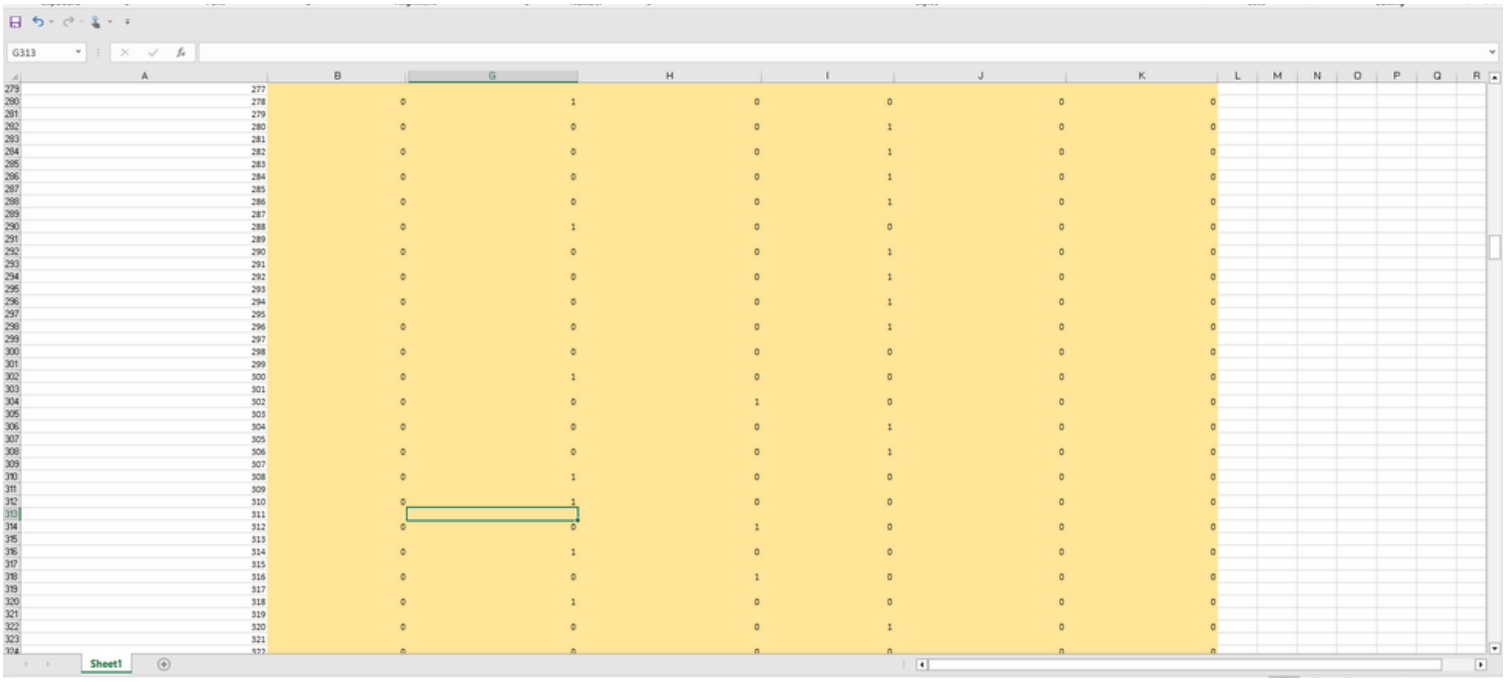
4.2 Observation

from 138 minute to 162 minute -it is observed that it is an episode of apnea where airflow data signifies it by 0.
The brain waves prevalent were beta and partially deta.

beta is highest in 11 discrete minutes with 4 minutes continuously.We also see that beta was increasing in the minutes before the episode.

delta is highest in 8 discrete minutes with 2 minutes continuously.

alpha is seen in only 2-3 minutes



5.0 Conclusion

During the episodes of apea-airflow stops accompanying with eye movements
In the brain , beta is prevalent before and during apnea , with fluctuations of delta and alpha waves.These fluctuations of delta and alpha waves are common in normal sleep , therefore the only thing to be noted was the increased beta waves.

6.0 Precautions

Through constant analysis of brain data , if we observe a surge in beta waves for more than 2 minutes it is likely an episode of apnea and the person can be woken up with help of a person or a machine to prevent it