Complex Engineering Problem

Introduction

Mental health is essential for Survival. This Project works on students with Arithmetic Solving skill by analyzing subject performance on math problems. we get to make products that help students concentrate better in mental challenges.

Data

The database contains EEG recordings of subjects before and during the performance of mental arithmetic tasks. The data files with EEG are provided in EDF (European Data Format) format. Each subject has 2 files:

- with "_1" suffix -- the recording of the background EEG of a subject (before mental arithmetic task)
- with "_2" suffix -- the recording of EEG during the mental arithmetic task.

The recording datetime information has been set to Jan 01 for all files.

In this experiment all subjects are divided into two groups:

- Group "G" (24 subjects) performing good quality count (Mean number of operations per 4 minutes = 21, SD = 7.4).
- Group "B" (12 subjects) performing bad quality count (Mean number of operations per 4 minutes = 7, SD = 3.6).

In subject-info.csv, the "Count quality" column indicates which subjects correspond to which group (0 - Group "B", 1 - Group "G"). Additionally, subject-info.csv provides basic information about each subject (gender, age, job, date of recording).

Procedure

A high-pass filter with a 30 Hz cut-off frequency and a power line notch filter (50 Hz) were used. All recordings are artifact-free EEG segments of 60 seconds duration. At the stage of data preprocessing, the Independent Component Analysis (ICA) was used to eliminate the artifacts (eyes, muscle, and cardiac overlapping of the cardiac pulsation).

Steps and Code

```matlab
N = 1024;
fs = 1000;

freq = (0:N-1)*fs/(N-1);

Xf = fft(x);
Mf = abs(Xf);
plot(freq,Mf,'k');
xlim([0 500]) title('Spectrum','FontSize',14);
xlabel('Frequency(Hz)','FontSize',14); ylabel('Magnitude','FontSize',14);


Xfiltered = highpass(Xf,30,fs);

[bl_low al_low] = bessel(1, 0.05, 'low');

%Finding & plotting frequency response

H_low = freqz(bl_low, al_low,floor(n/2));

plot([0:1/(n/2-1):1], abs(H_low),'r')

%filtered Signal

filtered = filter(bl_low, al_low, Xfiltered);
```
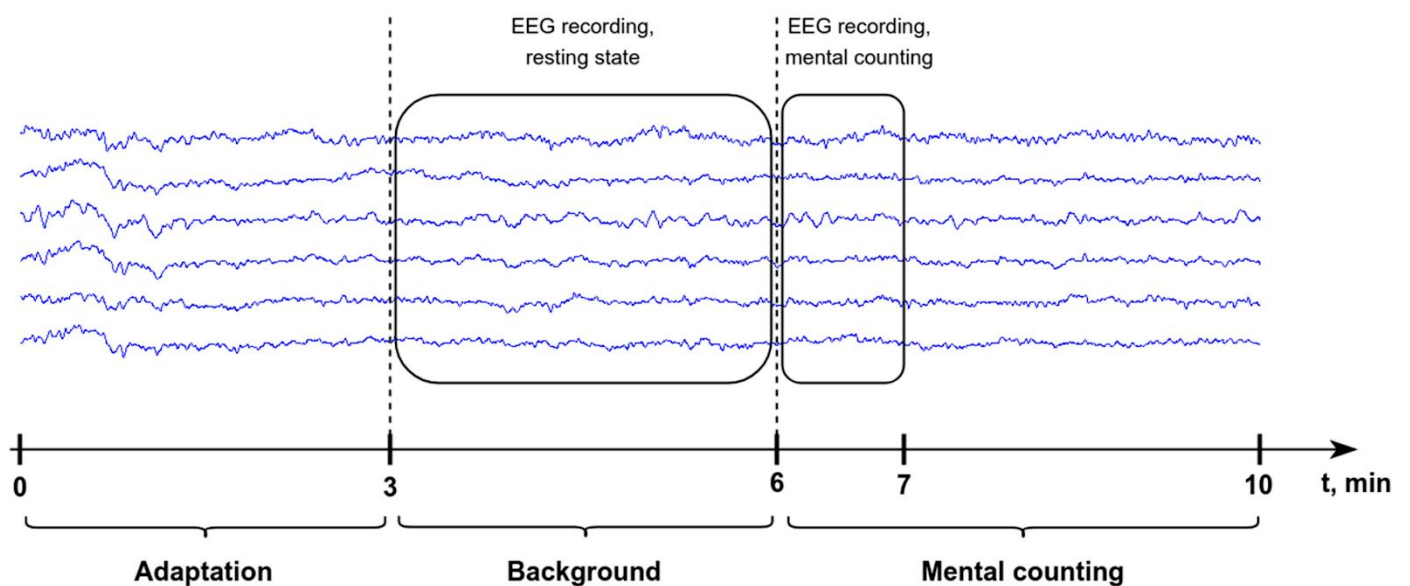
Future Application

By Doing this study we are able to identify Waveform and Areas of the brain to stimulate for better performance of Subjects in Mental Arithmetic Task. We can produce wearable devices for increasing the human computation power for Engineers, Scientists and people of all sorts. This can also help people suffering from neurodegenerative diseases in restoring mental function.