CSCE 363/3611 –Digital Signal Processing

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Project

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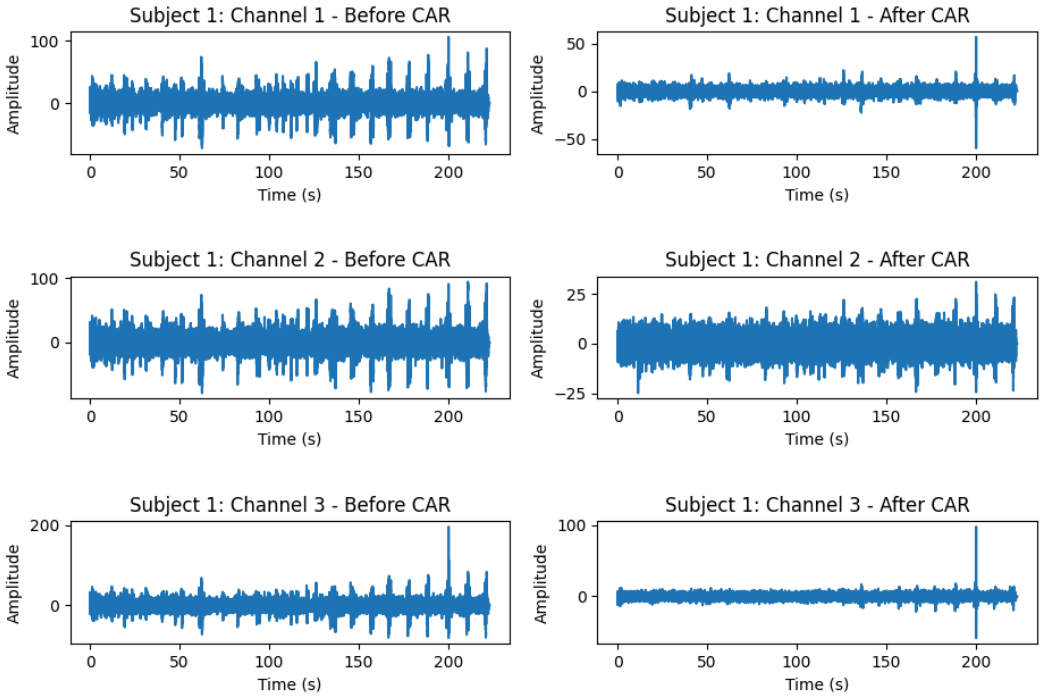
Overview of the Program

Data loading section loads the signals, labels, and sample time for a subject from the given csv files. CAR filtering will apply to the EEG signals of a subject to reduce the noise by subtracting the average signal of all channels from each channel. Plotting of CAR filter effect plots the first three EEG channels for subject 1 in order to represent the before and after effect. Bandpass filtering will apply it to the EEG signals to have only Mu: 7-13 Hz, and Beta 13-30 Hz. Feature extraction will calculate the computation of relative change in signal between the trial period and pre-onset for a given frequency band and channel. This feature will be used for KNN classification. The KNN classification will perform the k-nearest neighbor algorithm for each electrode and frequency band. Then the function will identify the best electrode and k value for the Mu and Beta band in order to minimize classification error. Then after the KNN_classification is computed for the three subjects we get to have the best electrode and k for the Mu and Beta band. Then we compute the average classification errors for the Mu and Beta band across all subjects.

Plotting Graphs of Before and After Applying CAR Filter



Graphing the first three channels of subject 1 before and after applying a common average filter on a time vs amplitude graph. The use of a CAR filter is to reduce noise of EEG signals as they are often contaminated with muscle activity, eye movements, and heartbeats. The use of the CAR filter helps calculate the average signal across all electrodes and then subtracts the average from each channel. This helps reduce the noise across all channels. In channel 1 and 3 we get to see a major noise reduction after CAR filtering. In channel 2 there exists peaks however we get to see a more bulky middle layer that may have reduced certain noise frequencies.

Ten-Fold Classification

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Subject 1: Mu band - Best electrode: 5, K: 2, Error: 0.15000000000000002
Subject 1: Beta band - Best electrode: 8, K: 2, Error: 0.19999999999999996
Subject 2: Mu band - Best electrode: 2, K: 1, Error: 0.19999999999999996
Subject 2: Beta band - Best electrode: 3, K: 1, Error: 0.25
Subject 3: Mu band - Best electrode: 10, K: 5, Error: 0.19999999999999996
Subject 3: Beta band - Best electrode: 2, K: 3, Error: 0.15000000000000002
Average across subjects: Mu band - Error: 0.18333333333333332
Average across subjects: Beta band - Error: 0.19999999999999998
```

Subject 1 the Mu band had the least error: 0.15, having the best electrode: 5 and k: 2. Subject 2 the Mu band had the least error: 0.1999, having the best electrode: 2 and k: 1. Subject 3 the Beta band had the least error: 0.15, having the best electrode: 2 and k: 3.

The differences across subjects include that subject 1 & 2 had the Mu band better than the Beta band. However, for subject 3 the Beta band is better than the Mu band. For all 3 subjects they had different electrodes as the best electrode for the Mu and Beta band separately. Subject 1 and 2 had their best electrode for the Mu and Beta band as the same K. On the other hand, subject 3 had different K values for the Mu and the Beta band.

Taking the average across all 3 subjects we get that the Mu band has the least error of 0.1833.