Weekly Work Report 9/27/2024

**This Week:** Comparison of Time-Frequency and Frequency Band Features in RF and KNN Classifiers

**Label**

Label = 0: Baseline, 1: Body Movement, 2: Aha Moment, 3: Confirmation Menu

A bar of numbers with green and orange squares

Description automatically generated with medium confidence

**Classification**

1. **Relaxed (baseline) vs Active state (Exam)**
2. Before Aha! Moment (Physical Body Movement) vs. Aha! Moment
3. Aha! Moment vs After Aha! Moment (Menu Confirmation)
4. **Preprocessing** of EEG in eeglab, cleaned your signals
5. **Classification, Prediction**
6. Analysis, explore correlation between signal & labels, **other signals**
7. **Use EEG signals to label our dataset**
8. **Models, ML, DL**

**Features**

* Time-Frequency
  + time window size = 3s
  + 16 Channels: max, min, std, mean
* **Frequency band**
  + **16 Channels: frequency**

# Define frequency bands

bands = {

'delta': (0.5, 4),

'theta': (4, 8),

'alpha': (8, 12),

'beta': (12, 30),

'gamma': (30, 45)

}

**Feature Importance: Relaxed vs Active state**

* Feature importance from RF
  + **All Time-Frequency features**

A graph of blue columns

Description automatically generated with medium confidence

* + **All** Frequency Band **features**

A graph of blue bars

Description automatically generated

* Feature importance from KNN
  + **All Time-Frequency features**

A graph of blue and white lines

Description automatically generated with medium confidence

* + **All** Frequency Band **features**

A graph of blue bars

Description automatically generated

**Result: Relaxed vs Active state**



**Feature Importance: Before Aha! Moment vs Aha! Moment**

* Feature importance from RF
  + **All Time-Frequency features**

A graph of blue lines with white text

Description automatically generated

* + Removed low-importance features

A graph of blue bars

Description automatically generated

* + **All Frequency Band features**

A graph of blue vertical bars

Description automatically generated

* + Removed low-importance features

A graph of blue bars

Description automatically generated

* Feature importance from KNN
  + **All Time-Frequency features**

A graph of a number

Description automatically generated with medium confidence

* + Removed low-importance features

A graph of blue bars

Description automatically generated

* + **All Frequency Band features**

A graph of blue bars

Description automatically generated

* + Removed low-importance features

A graph of blue bars

Description automatically generated

**Result: Before Aha! Moment vs Aha! Moment**



**Feature Importance: Aha! Moment vs After Aha! Moment**

* Feature importance from RF
  + **All Time-Frequency features**

A graph of blue lines with white text

Description automatically generated

* + Removed low-importance features

A graph of blue bars

Description automatically generated

* + **All Frequency Band features**

A graph of blue vertical bars

Description automatically generated

* + Removed low-importance features

A graph of blue bars

Description automatically generated

* Feature importance from KNN
  + **All Time-Frequency features**

A graph of blue lines and numbers

Description automatically generated with medium confidence

* + Removed low-importance features

A graph of blue bars

Description automatically generated

* + **All Frequency Band features**

A graph of blue bars

Description automatically generated

* + Removed low-importance features

A graph of blue bars

Description automatically generated

**Result: Aha! Moment vs After Aha! Moment**



**Comparison of Time-Frequency and Frequency Band Features in RF and KNN Classifiers - No features removed**

**A table with numbers and letters

Description automatically generated**

**Comparison of Time-Frequency and Frequency Band Features in RF and KNN Classifiers – Low-importance features removed**

**A table with text on it

Description automatically generated**

**Overall results**

**A table with text and numbers

Description automatically generated**

**Next Week:**

* Conduct a literature review on labeling, brain structure, and functionality.
* Continue processing EEG data for the remaining subjects in the dataset.
* Begin processing additional signals, including EDA and pupil data.
* Engage in knowledge transfer with Wiam, gaining insights from her expertise.
* **Explore the dynamics of attention, stuck states, and the "Aha!" moment.**
* **ROC Curve:** plot Precision/Recall for KNN, RF
* To treat as detection problem
* Consider using larger window size 10 seconds?
* Add more architectures /models/ NN: **TSCeption, EEGNet**
* Choose the best one: model selection: pupil, EDA, EEG
* frequency bands

A screenshot of a graph

Description automatically generated