



Tasks results

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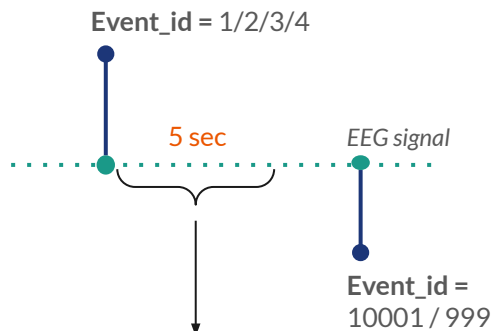


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Task 1: Binary classification of SSVEP response based on focused flickering stimuli

- Signal processing: Notch filter, bandpass filter, wavelet transform
- Feature extraction: Linear envelope + RMS, CWT, FFT stats, DWT stats, FFT stats + entropy, all combined, all combined w PCA (principal_df)
- Classes: **10001** (7.5 Hz confirmed stimuli), **999** (confirmed no stimuli)



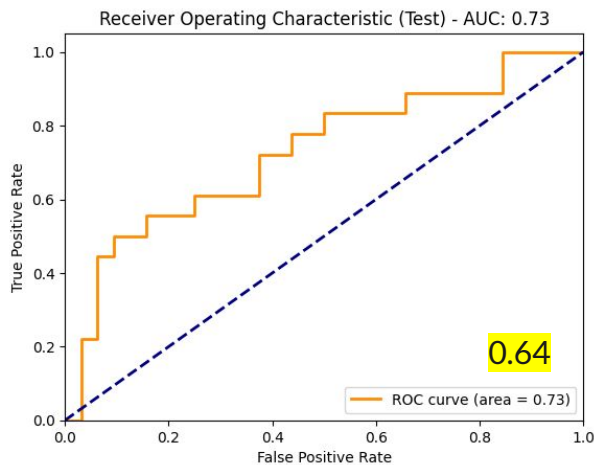
Feature Extraction

Split train/val/test

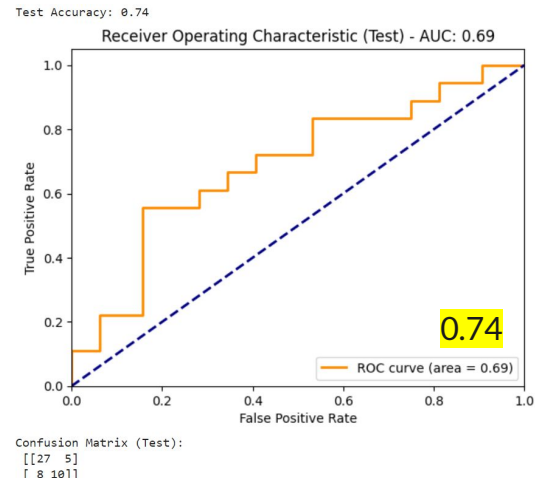
SVM model

MLP model

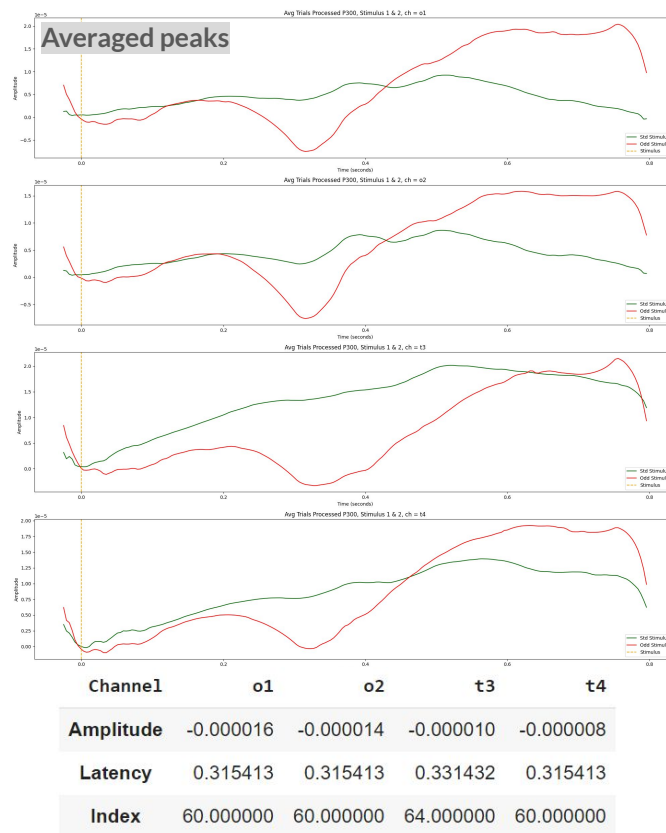
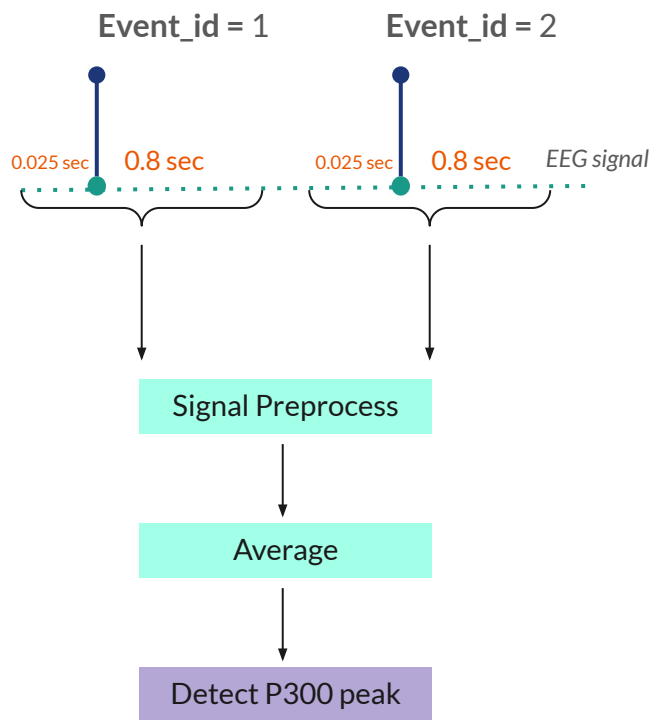
SVM **accuracy*** for all features
principal_df components



Hyper parameter-tuned MLP **accuracy***
for FFTstat_entropy features



Task 2: Detecting P300 peak from stimuli 1 (std) & stimuli 2 (odd)



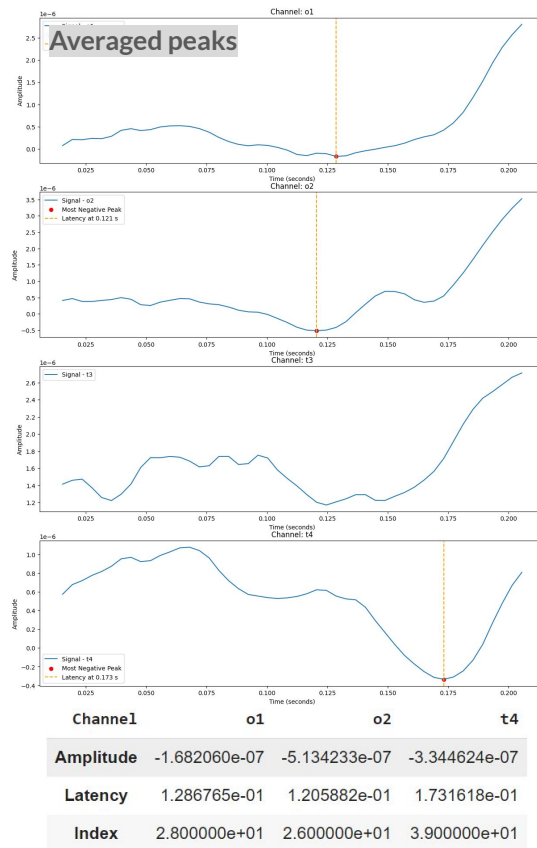
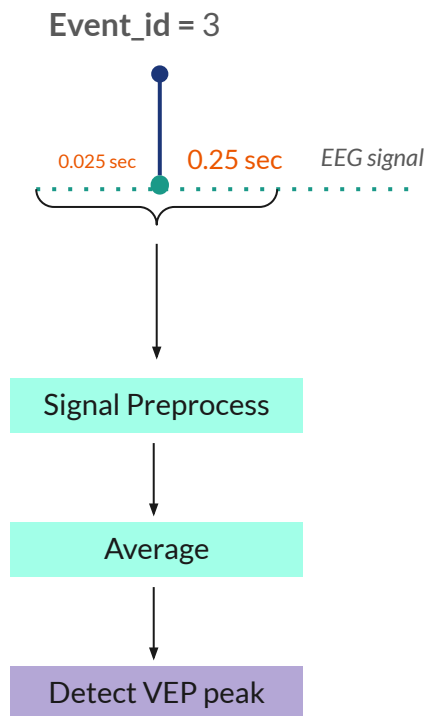
Preprocessing signals: Data imputation, baseline correction, notch filter, bandpass filter, wavelet transform

Odd stimuli

- Stronger response
- $> 7 \mu V$
- Amplitude and latency detection method: 'find_peaks' from `scipy.signal`

Improvement: Could remove outlier files to improve signal to noise ratio while averaging

Task 3: Detecting VEP peak from stimuli (event_id = 3)



Preprocessing signals: Data imputation, high pass filter, notch filter, bandpass filter, wavelet transform

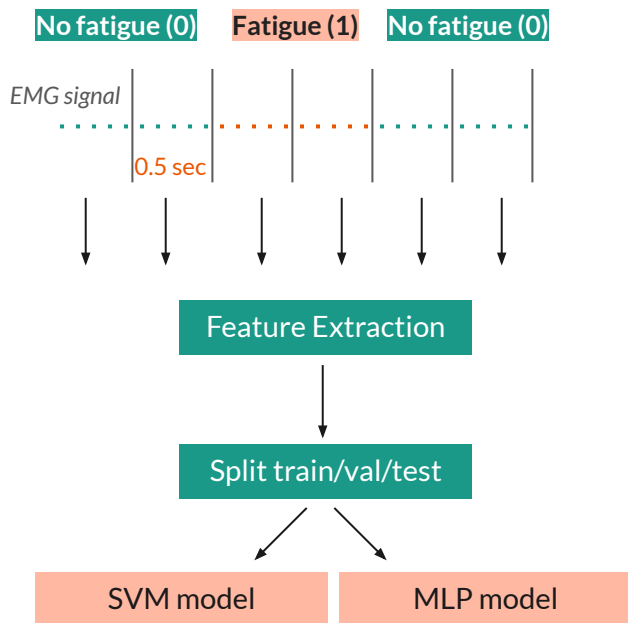
VEP response

- Negative peak
- Shape partially visible after averaging
- Peak too small after averaging
- Amplitude and latency detection method: 'find_peaks' from scipy.signal

Improvements

- Could remove outlier files to improve signal to noise ratio while averaging
- More refined preprocessing techniques to remove noise, quantify using signal to noise ratio

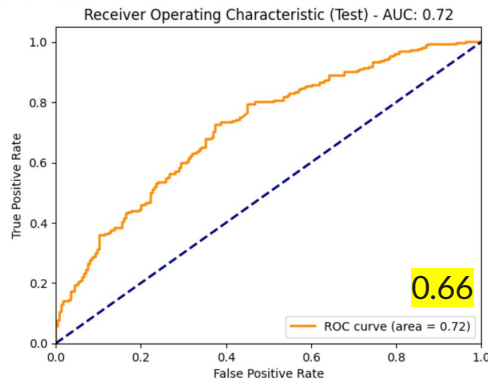
Task 4: Binary classification of fatigue and no-fatigue response from EMG segments



- Signal processing: Notch filter, wavelet transform, bandpass filter
- Feature extraction: Linear envelope + RMS, CWT, FFT stats, DWT stats, FFT stats + entropy, all combined, all combined w PCA
- Classes: **1** (fatigue), **0** (no fatigue)

Hyper parameter-tuned SVM **accuracy*** for all features data

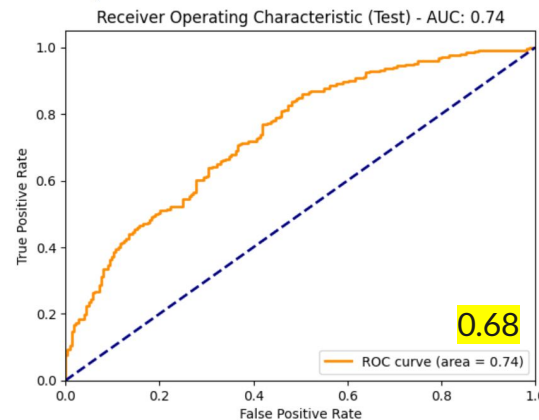
Best Hyperparameters: {'C': 1, 'gamma': 'auto', 'kernel': 'rbf'}
Test Accuracy: 0.6631578947368421



Confusion Matrix (Test):
[[126 98]
[62 189]]

MLP model **accuracy*** for all features data

Test Accuracy: 0.6842185263157895



My learnings

- EEG data is complex, requires higher level of analysis (outlier detection through clustering) and more robust processing techniques.
- EEG signals are sensitive and unique, would need to ensure each data point is useful for analysis (through thresholding or a quantitative assessment). Could lead to class imbalance for machine learning.
- Machine learning is an iterative process, would only achieve a good accuracy when you train with more data and experiment with more features and hyper parameters.
- More complex machine learning models would be required to perform accurate classification (CNN, ResNET, Transformers, deeper MLP).

Thank you!
