Self Paced Brain Computer Interface On Sensorimotor Rhythms For Virtual Objects Controlling

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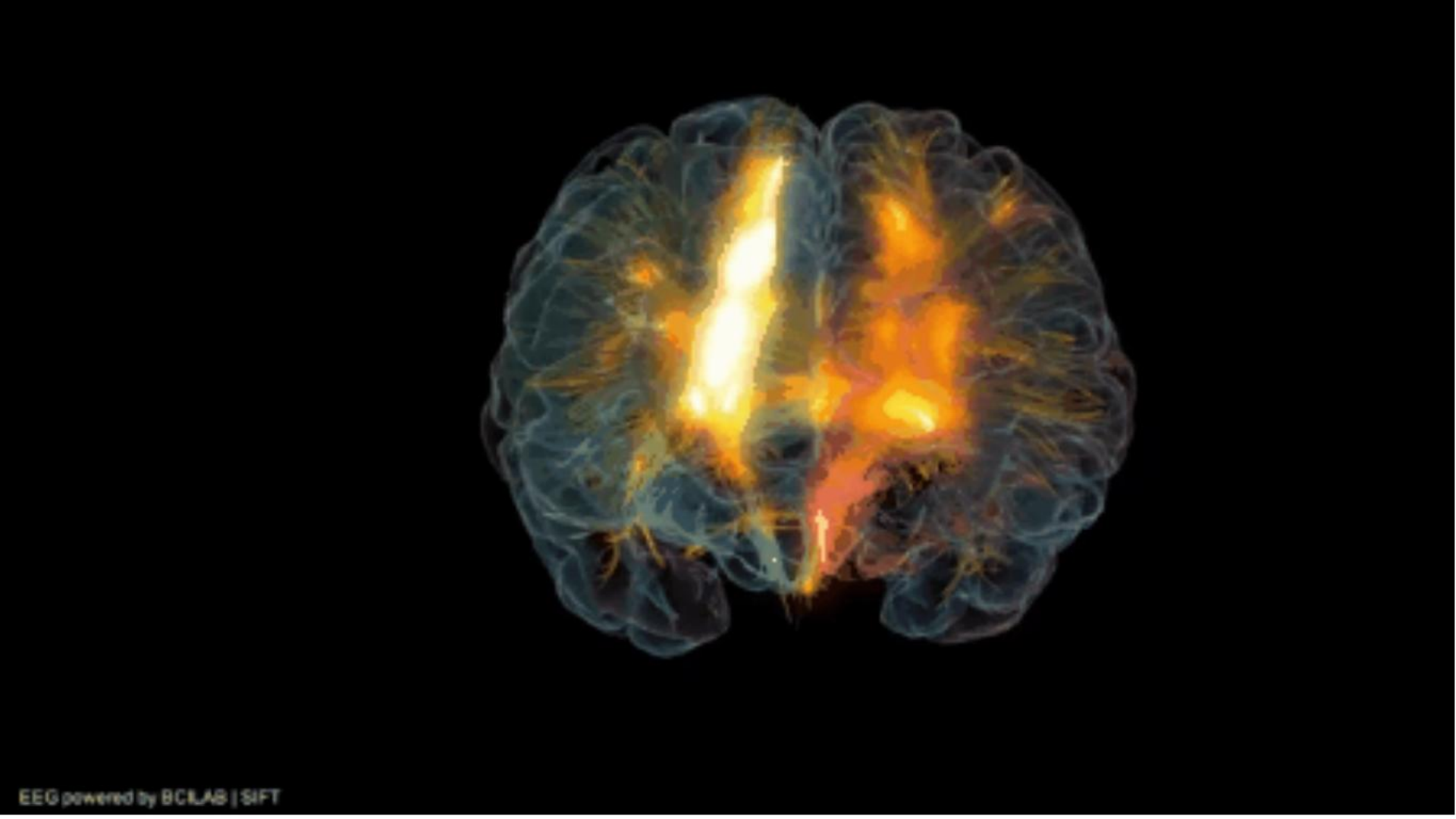
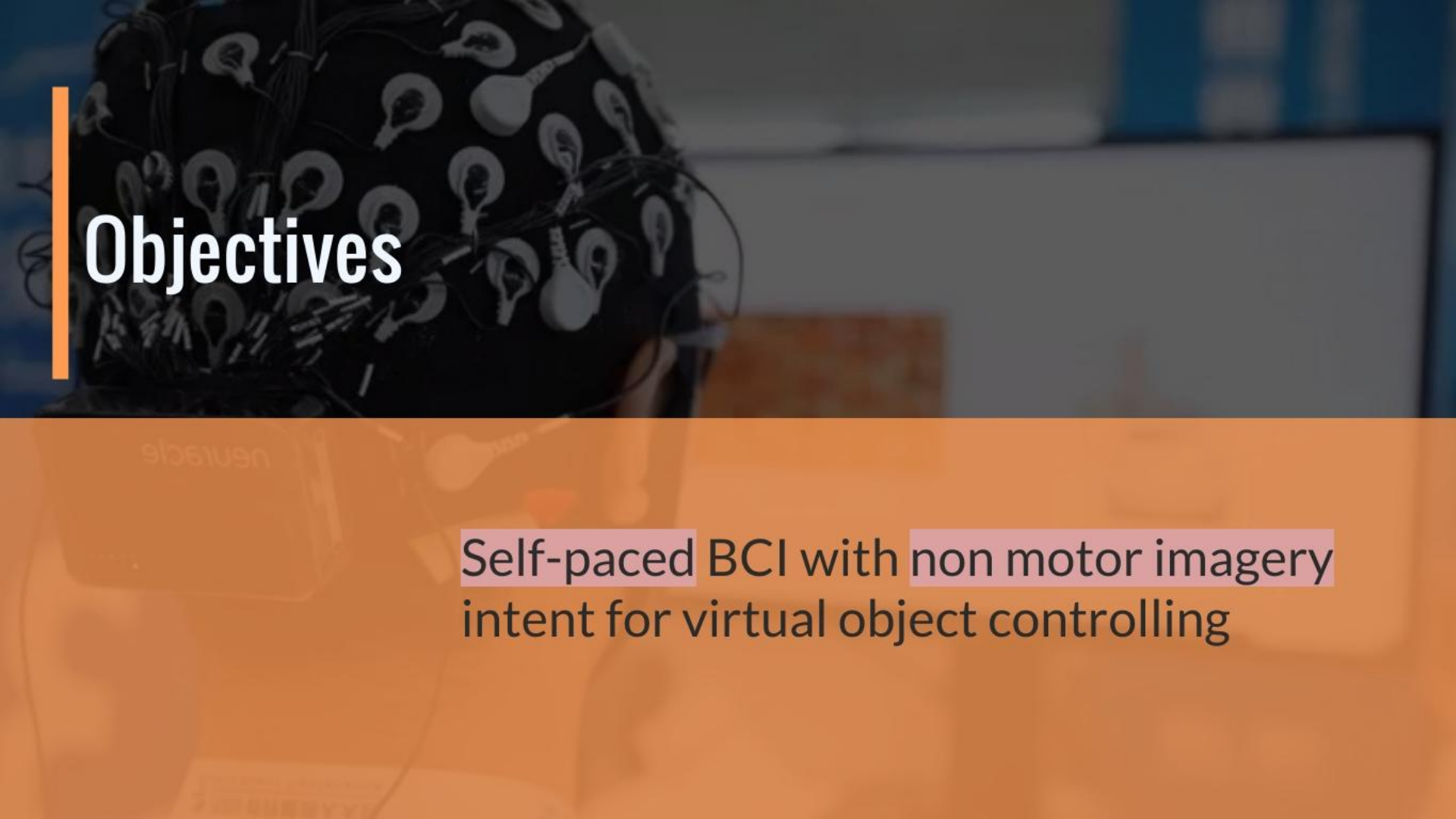
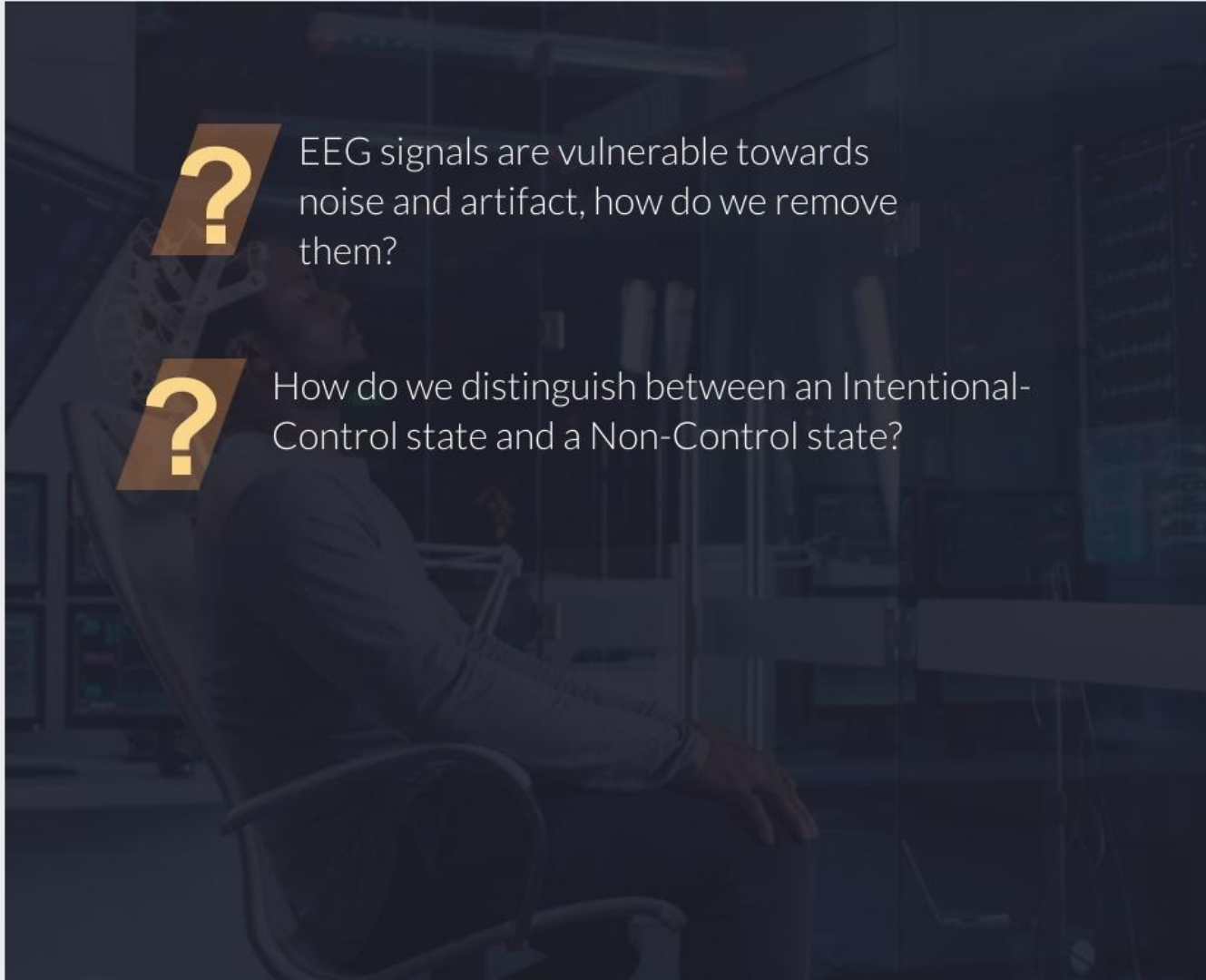

EEG powered by BCILAB | SIFT



Objectives

Self-paced BCI with non motor imagery intent for virtual object controlling

Problems that have emerged



? EEG signals are vulnerable towards noise and artifact, how do we remove them?

? How do we distinguish between an Intentional-Control state and a Non-Control state?

Related work

Self-paced MI related BCI

- Robert Lee and his team researched on Wheel chair control- in 2007
  Success rate 90%
- Graz University VR BCI system
  TPR 50%
  FPR 10%
- Graz University VR System
  TPR 79%
  FPR 0.67%

Self -Paced Non MI related BCI

- Faradji did a study on virtual object controlling
  TPR 59.98%

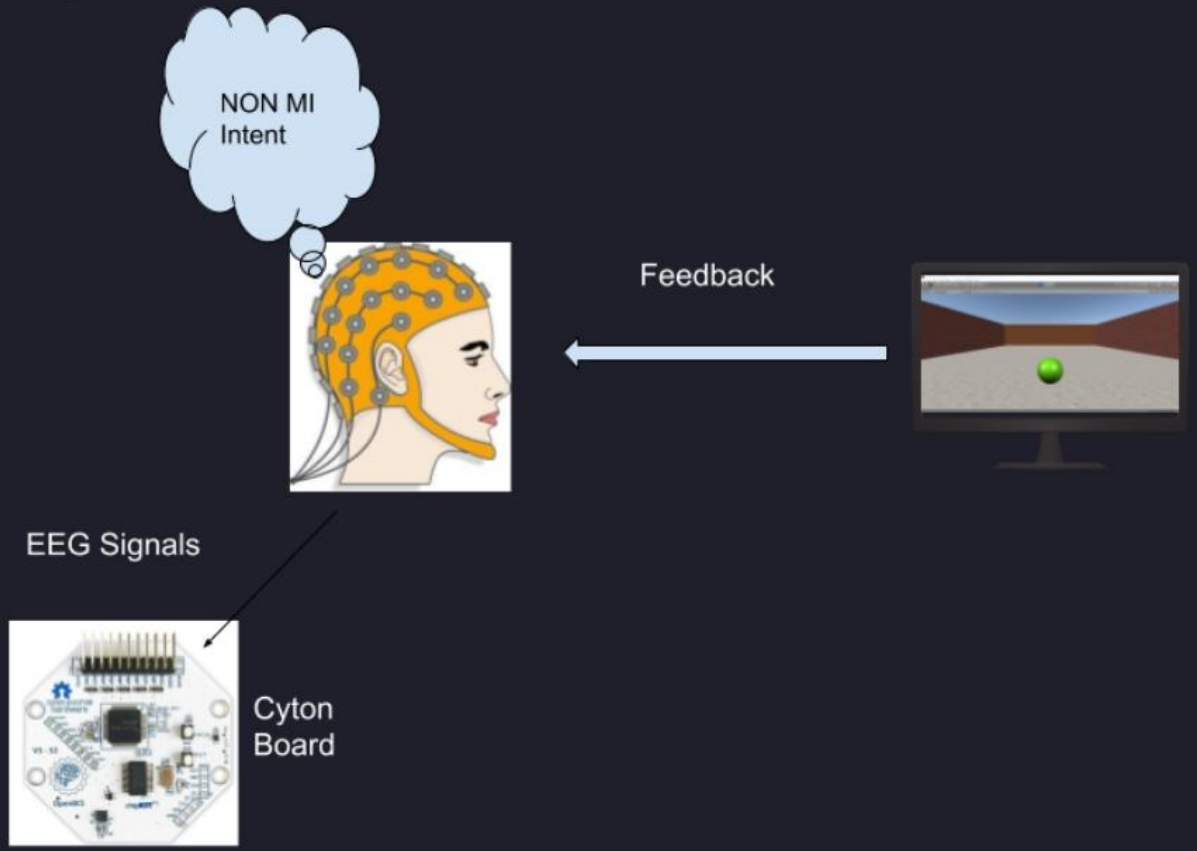
Signal Processing

- Krusienki Deanj in 2011 discuused critial issues in EEG signal processing related to BCI

Signal Classification

- Zahg, Dalin studied a signal classfication method that uses 98.3% accuracy
- Rodpongpun, Sura did a comparison between different classification methods

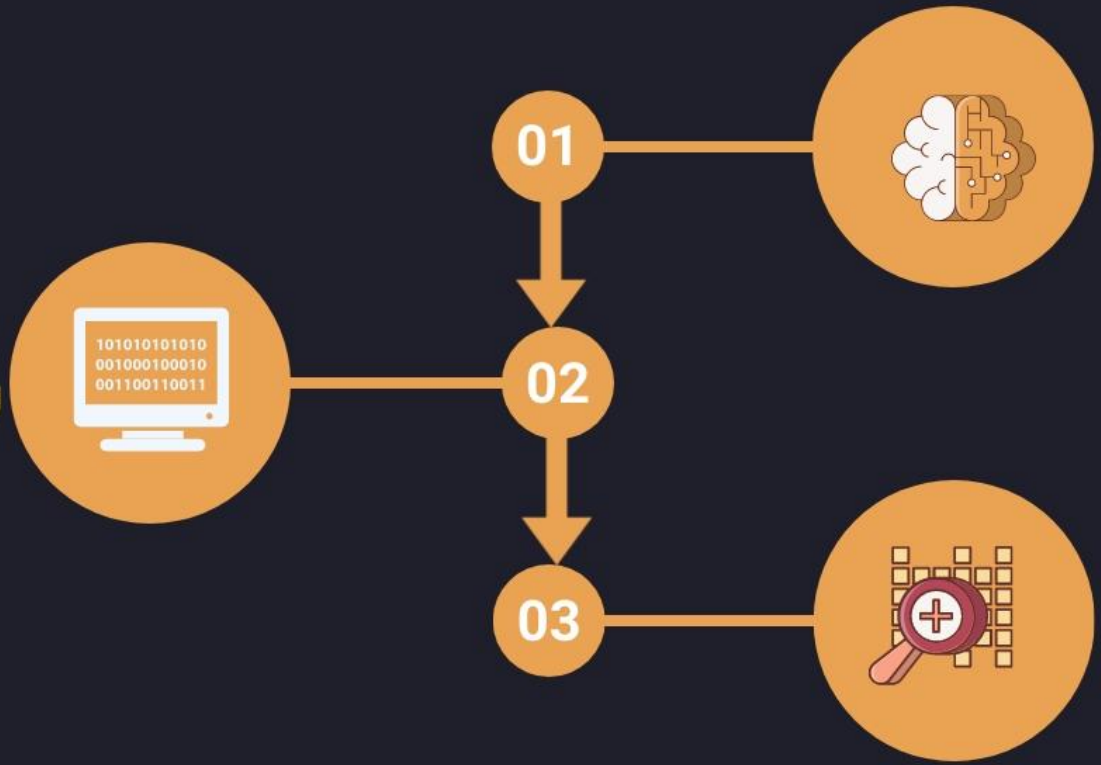
Data acquisition



Methodology

1. Practicing without Visual Feedback
2. Data acquisition and preprocessing
3. Feature extraction
4. Training a classification model
5. Applying the model to the real time system
6. Feed the classification output into an application
7. Upgrade the System to Online adaptation

Milestones for Current Semester



Week 4-6
Data acquisition

Training without feedback

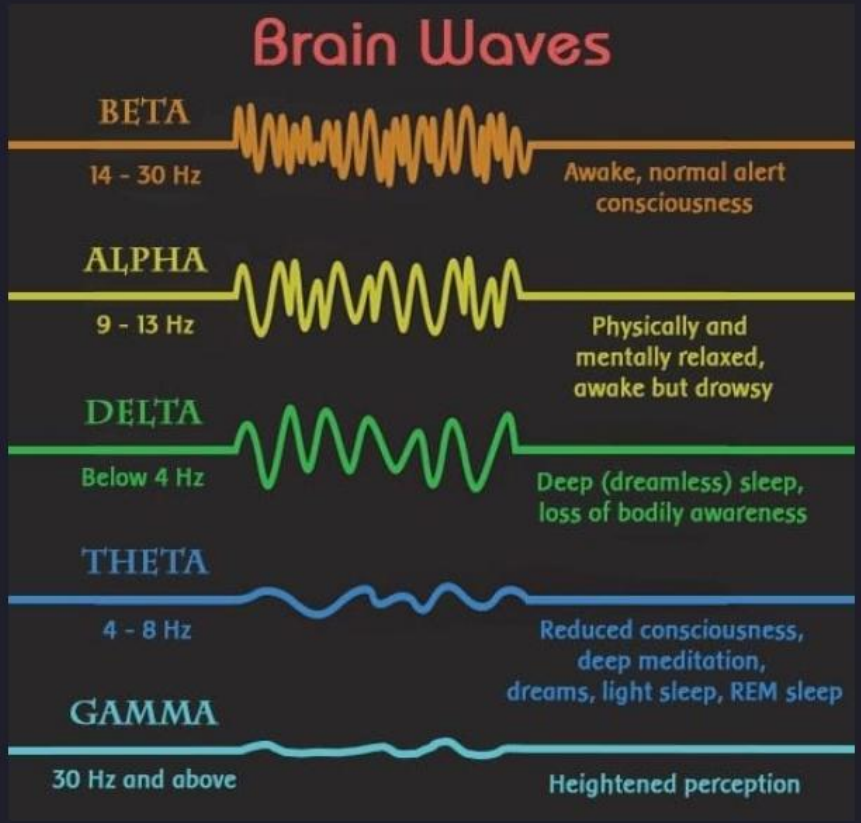
Week 7-8
Data preprocessing

Artifact removal

Week 9 onwards
Feature extraction

Feature identification

BrainWaves

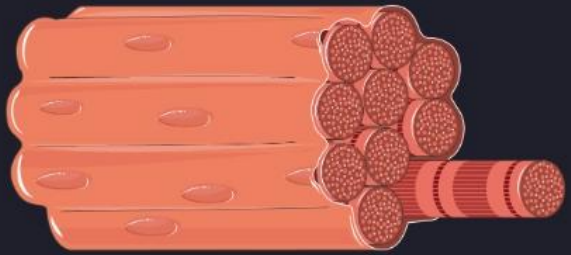

Brain Waves
BETA
14 - 30 Hz
Awake, normal alert consciousness
ALPHA
9 - 13 Hz
Physically and mentally relaxed, awake but drowsy
DELTA
Below 4 Hz
Deep (dreamless) sleep, loss of bodily awareness
THETA
4 - 8 Hz
Reduced consciousness, deep meditation, dreams, light sleep, REM sleep
GAMMA
30 Hz and above
Heightened perception

Signal Representations

Fast Fourier Transformation	• Low computational cost • Magnitude of frequency components visualized	• No temporal information • Not good for non stationary signals
Wavelet Transformation	• Both spatial and temporal information • More suitable for non stationary signals	• Computational cost is high • Need chose proper mother wavelet
Statistical Representations	• Low computational cost	• Low information resolution

Artifacts

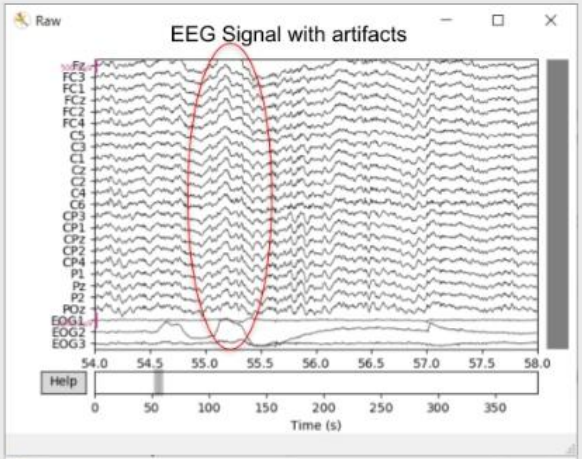
Eye artifact
0-5 Hz

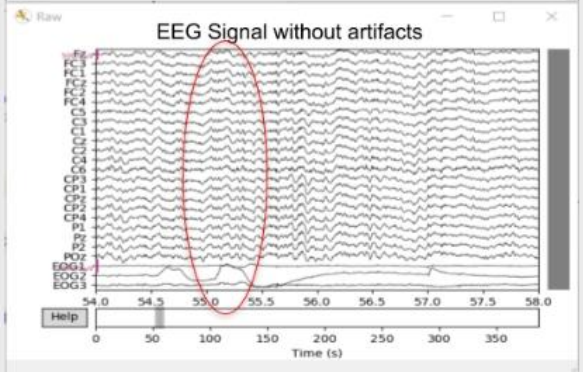


Muscle artifact
above 40 Hz

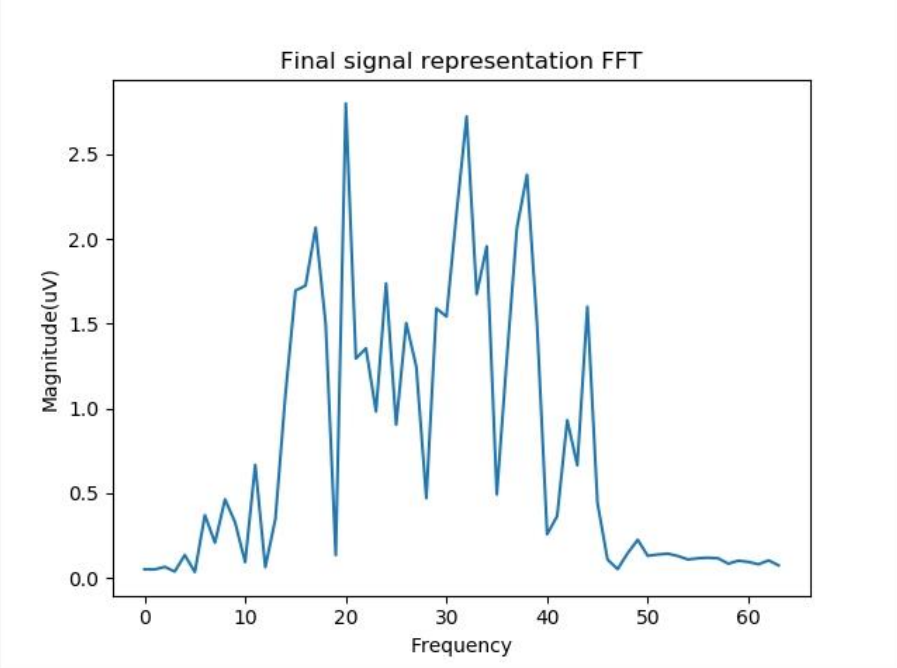
Artifact Removal

Independent Component Analysis



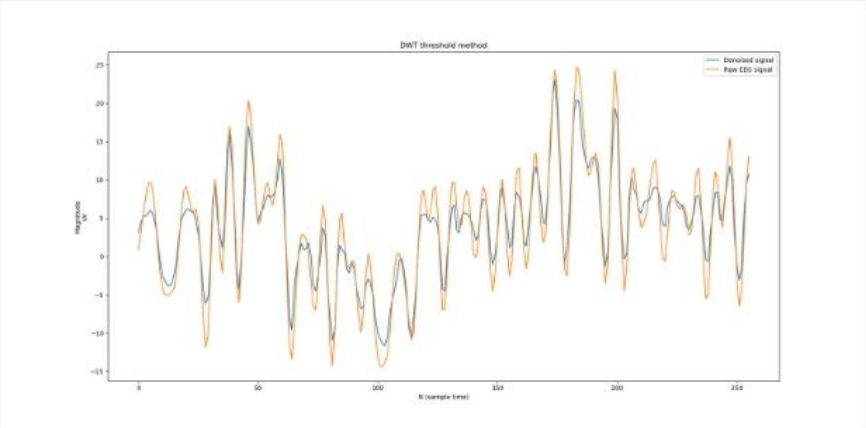


FFT and Removal of Coefficients

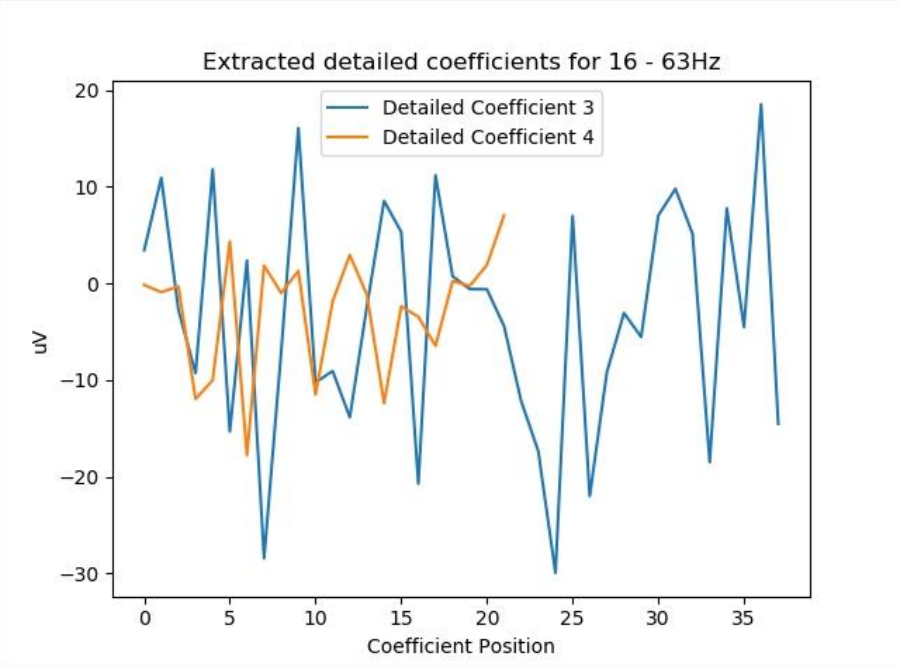


Artifact Removal

Wavelet Threshold Method



Wavelet Non-Threshold Method



Methods Comparison

Method	Information Resolution	Computational Cost	Real time
ICA	High	Very High	No
FFT with Coefficients removal	Low	Low	Yes
Wavelet with Threshold	High but with noise	Medium	Yes
Wavelet with Non-Threshold	High	Medium	Yes

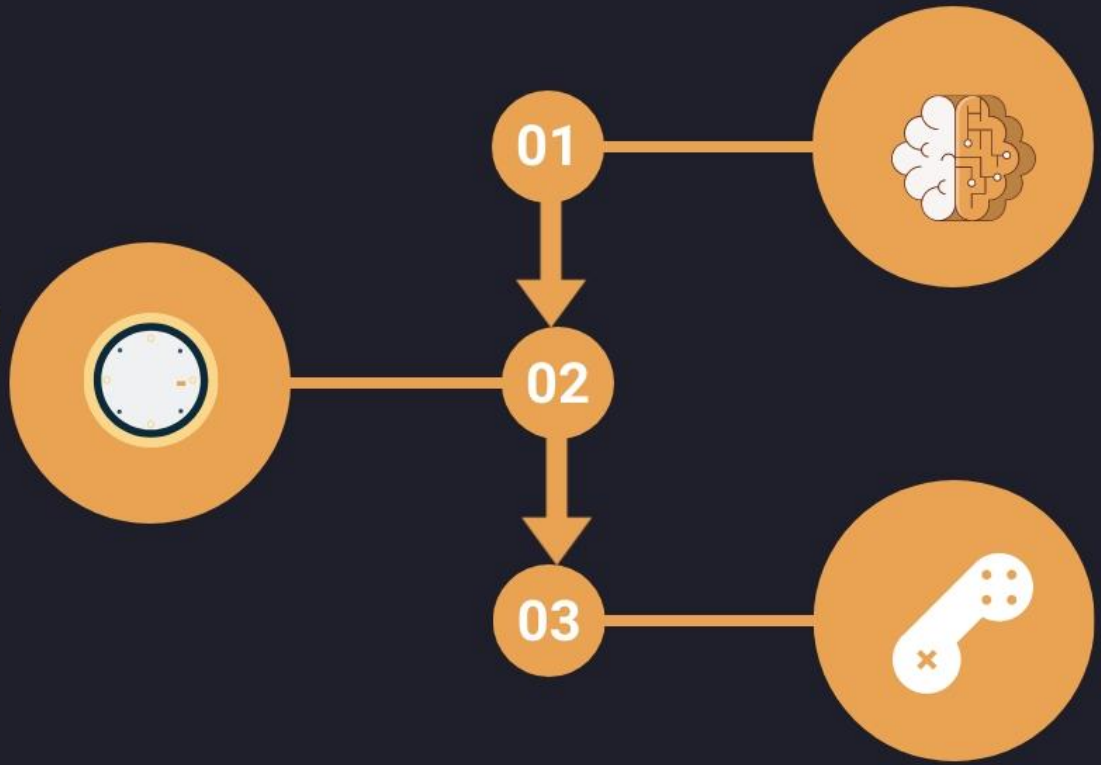
Technology Stack

Open BCI

Python

Unity

Milestones for Next Semester



Q&A