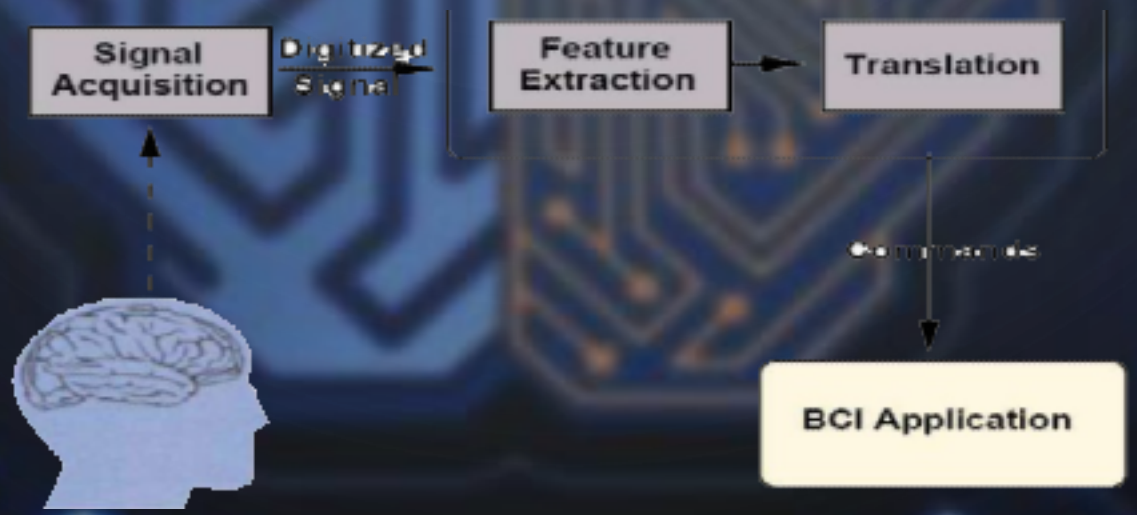
BRAIN-COMPUTER INTERFACE

PRESENTATION BY: SAHAJ SHAKYA

192919

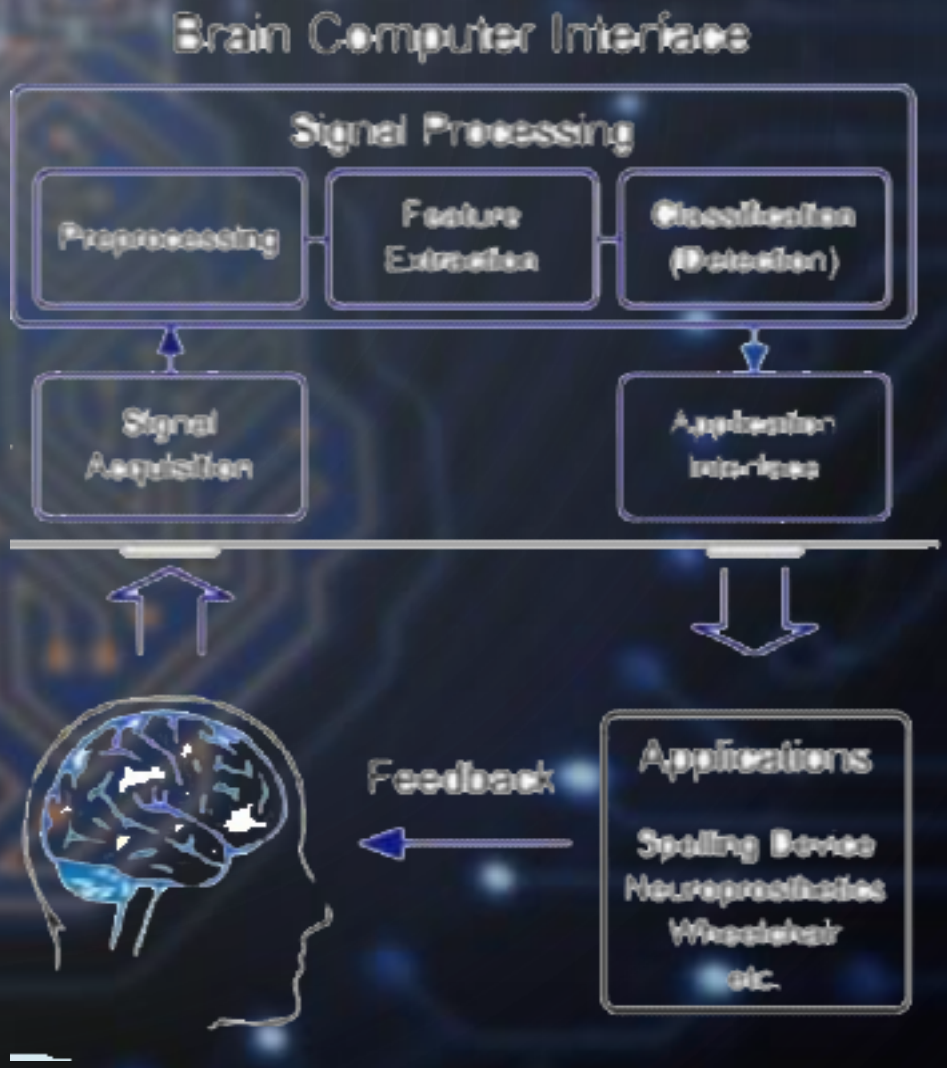
INTRODUCTION:

- Brain-computer interfaces are direct pathways of communication between the brain and some external device.
- Study of Brain Functions.
- Control system that bridges gap between neurons and machine.



BASIC COMPONENTS:

- Implant Device (Electrodes)
- Signal recording and Processing
- External Device to control
- Feed back Device Control



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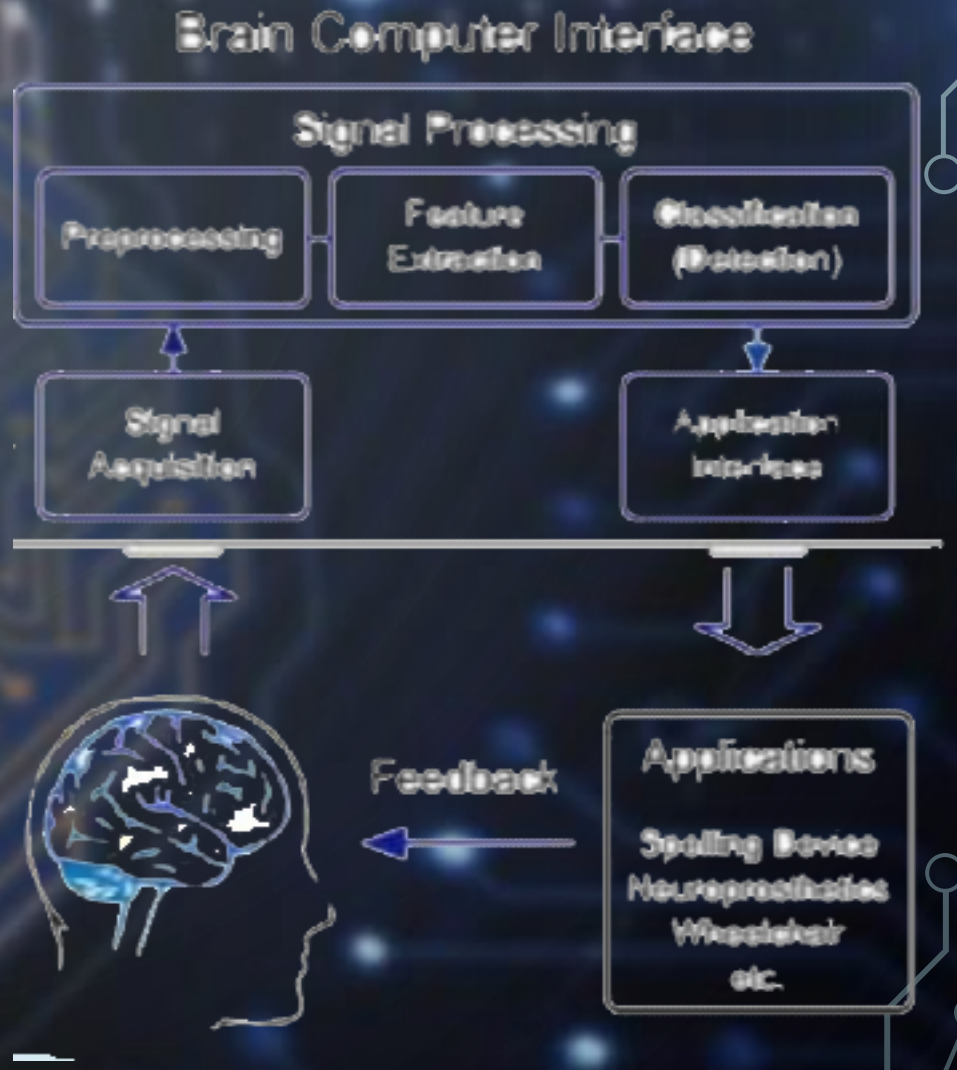
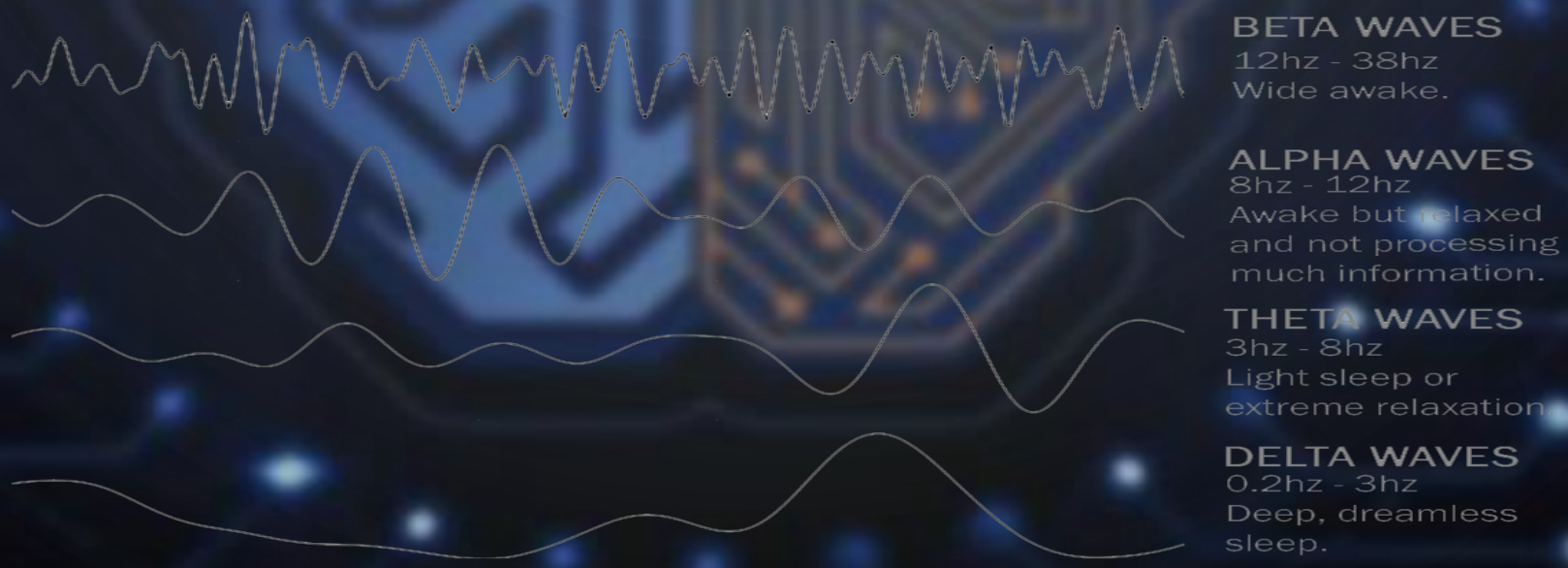


SIGNALS IN BCI

1. Delta (0.1-3)

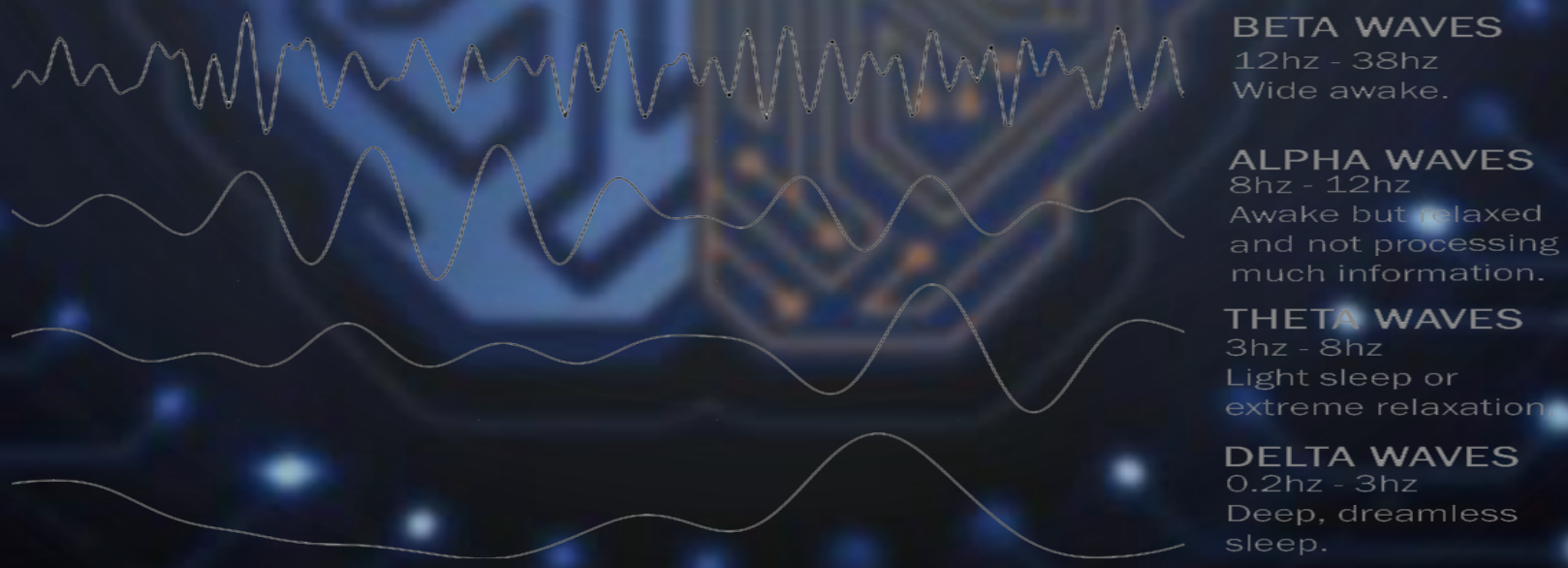
- Delta is the frequency range up to 4 Hz.
- Tends to be the highest in amplitude and the slowest waves.
- Seen normally in adults in slow-wave deep sleep.



SIGNALS IN BCI

2. Theta (4-7)

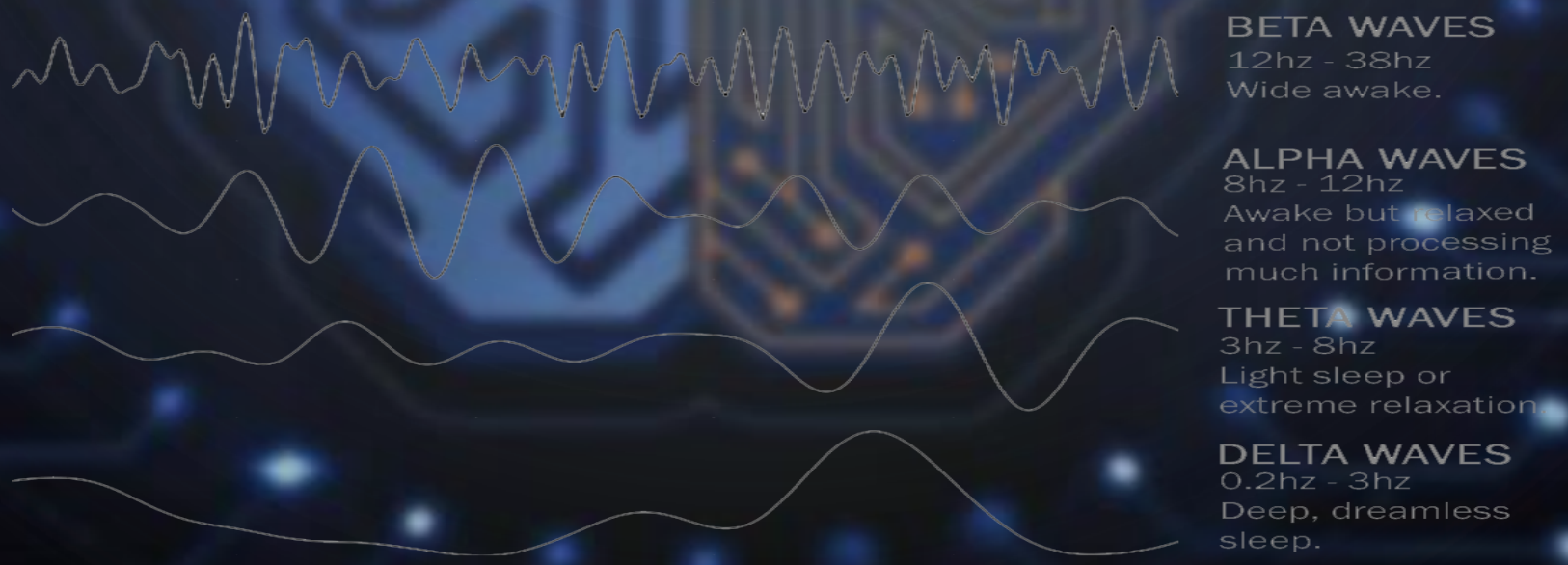
- Frequency range from 4 Hz to 7 Hz.
- Seen in drowsiness and in meditative.



SIGNALS IN BCI

3. Alpha (7-13)

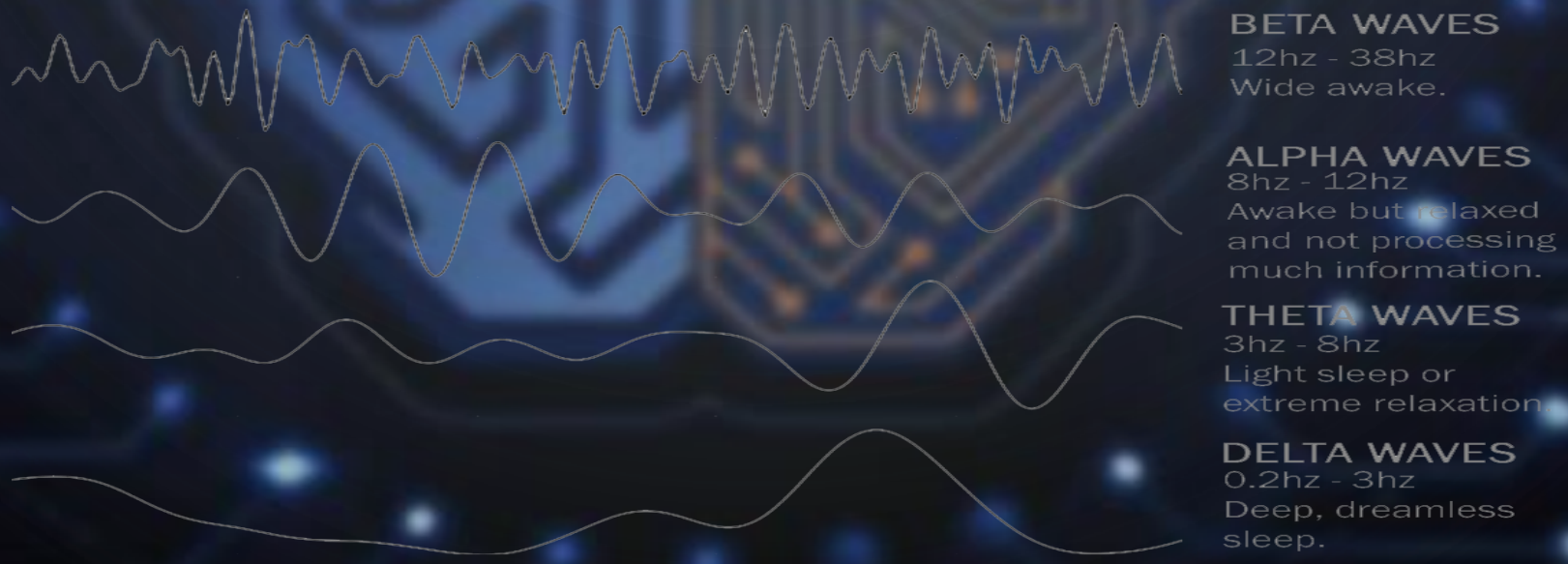
- is the frequency range from 7 Hz to 13 Hz.
- higher in amplitude on the dominant side.
- emerges with closing of the eyes and with relaxation, and attenuates with eye opening.



SIGNALS IN BCI

4. Beta (14-30)

- is the frequency range from 14 Hz to about 30 Hz.
- linked to motor behaviour and is generally attenuated during active movements.
- Dominant rhythm in patients who are alert or anxious or who have their eyes open.



SIGNALS IN BCI

4. Beta (14-30)

- is the frequency range from 14 Hz to about 30 Hz.
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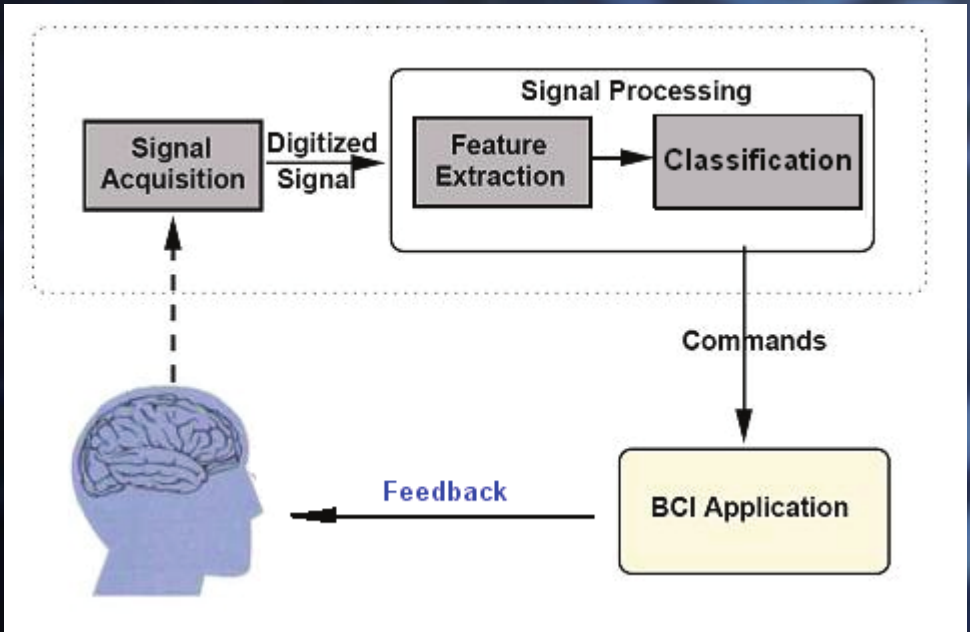
5. Gamma(30-100)

- Purpose of carrying out a certain cognitive or motor function.

PHASES

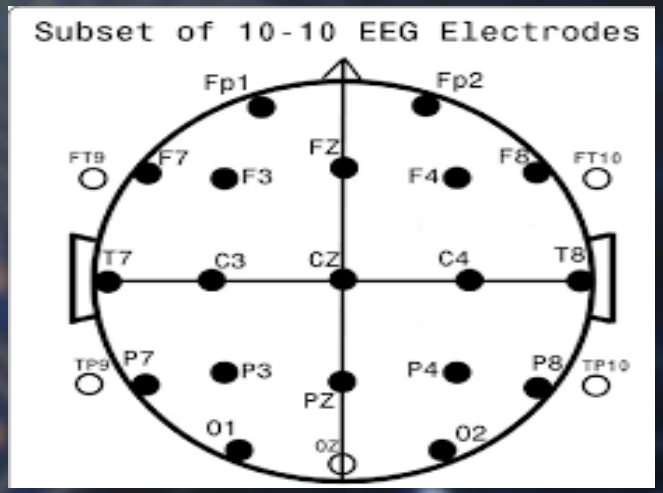


- Extraction
- Processing
- Interfacing

PHASES

EXTRACTION:

- Electrode Position
- Locate reference Electrode (eg: EEG_A are Fp1 and Fp2)
  - EEG(Fp1) = V(Fp1) + Noise
  - EEG(Fp2) = V(Fp2) + Noise
- Calculate the Potentials
  - EEG_A = EEG(Fp1) - EEG(Fp2) = V(Fp1) – V(Fp2)



PHASES

PROCESSING:

- Frequency Domain:
  - Processing in terms of Frequency.
  - Power Spectral Density of each Classification is calculated.
- Time Frequency Representation:
  - Time Frequency Extraction Algorithms are used
  - FFT, SFT, Wavelet Transformation

PHASES

PROCESSING:
FREQUENCY DOMAIN:

FIG: RAW DATA

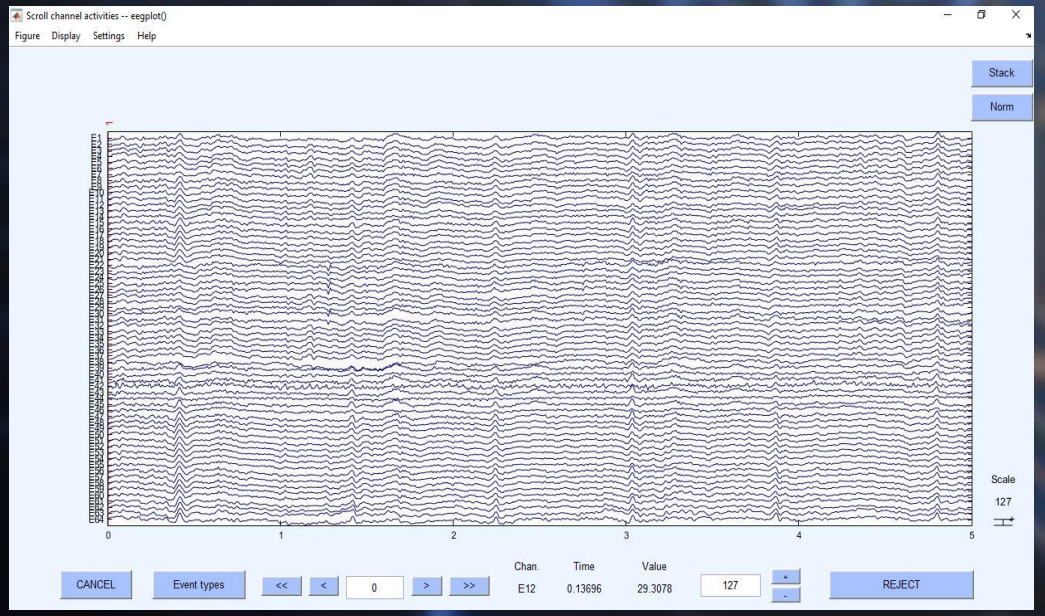
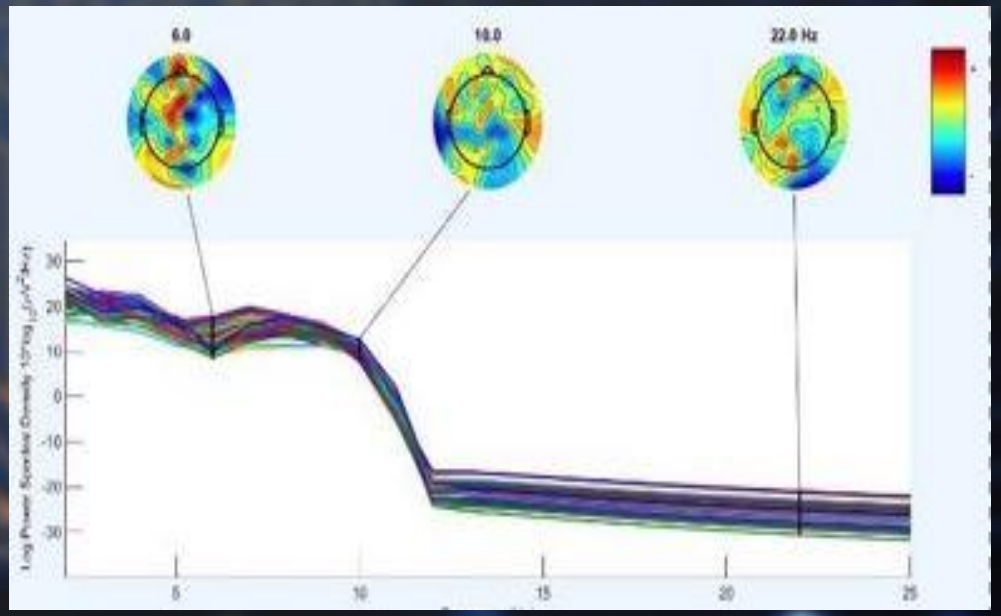


FIG: POWER SPECTRAL



PHASES

PROCESSING:
TIME-FREQUENCY DOMAIN

FIG: RAW DATA

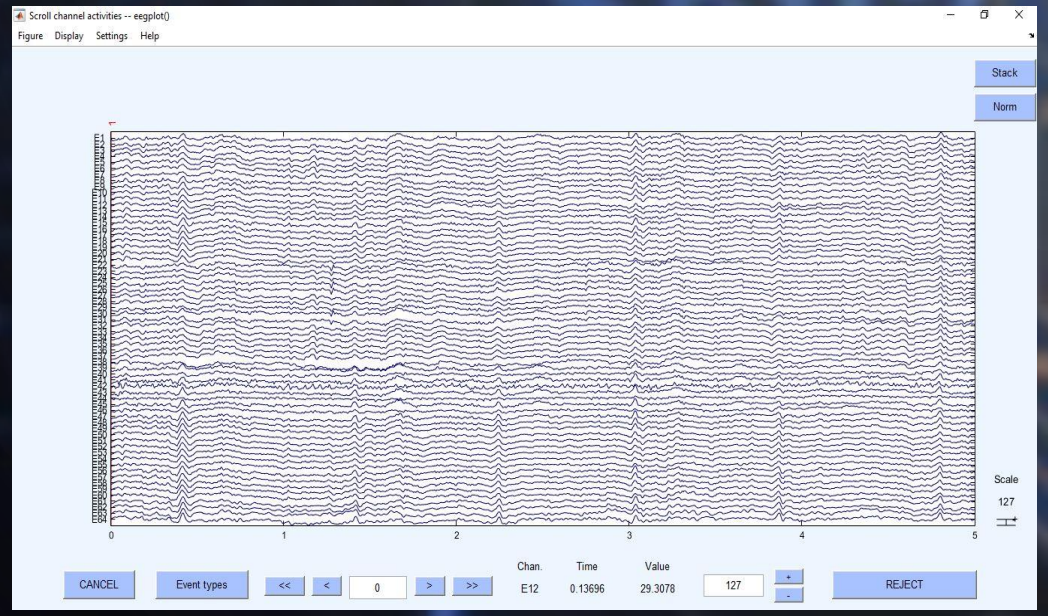
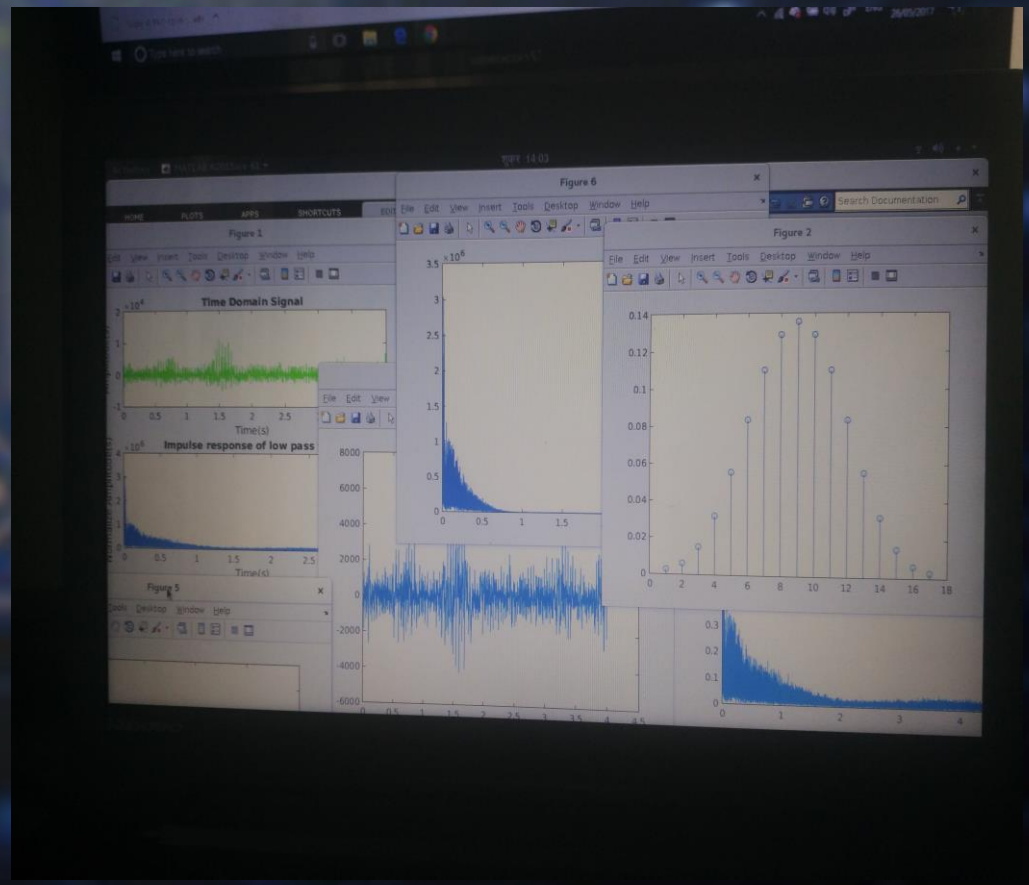


FIG: TIME-FREQUENCY REPRESENTATION



PHASES

PROCESSING:
TIME-FREQUENCY DOMAIN

FIG: WAVELET

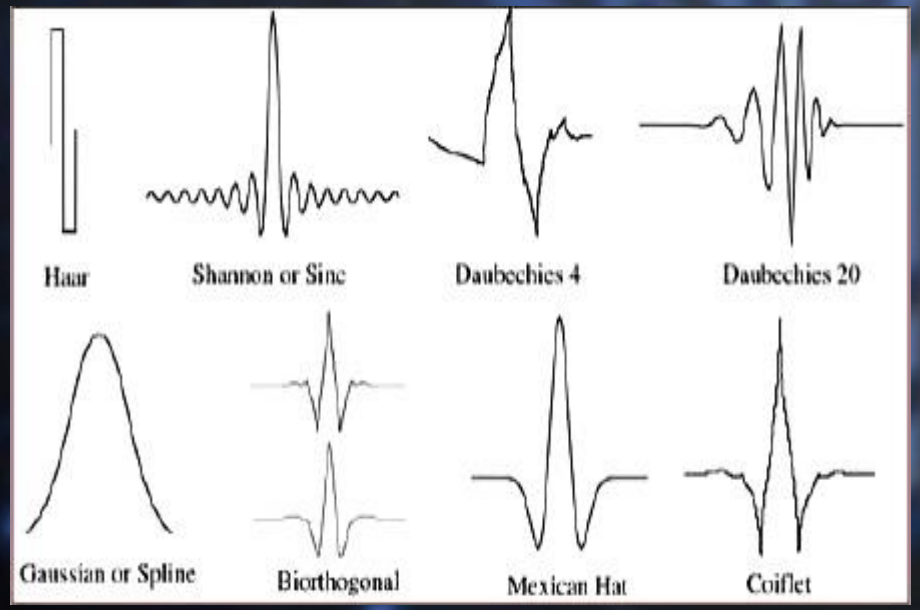
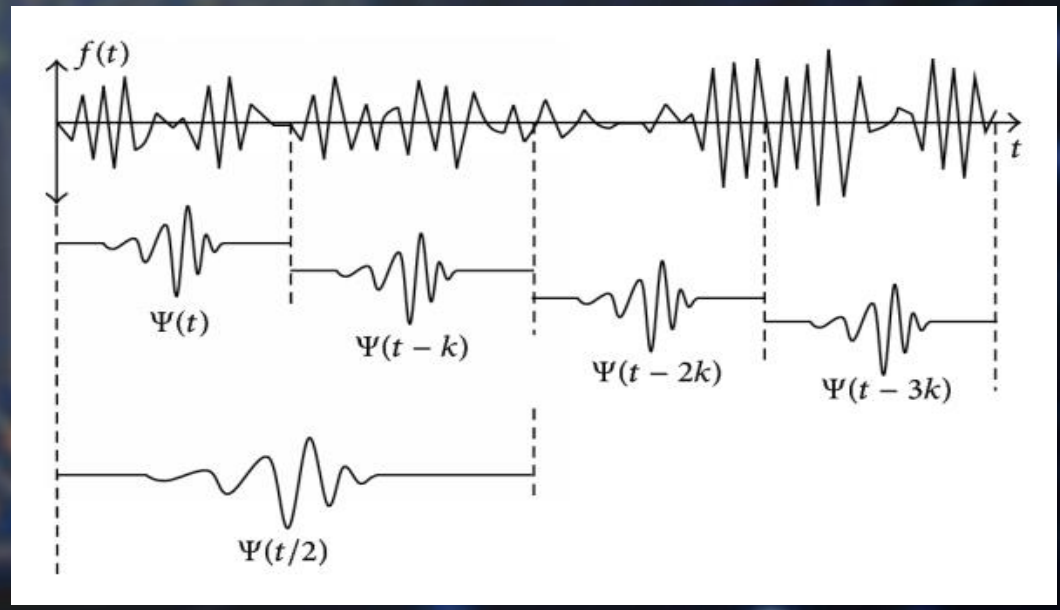


FIG: SHIFING AND SCALING



PHASES

PROCESSING:
TIME-FREQUENCY DOMAIN

FIG: WAVELET AND FREQUENCY

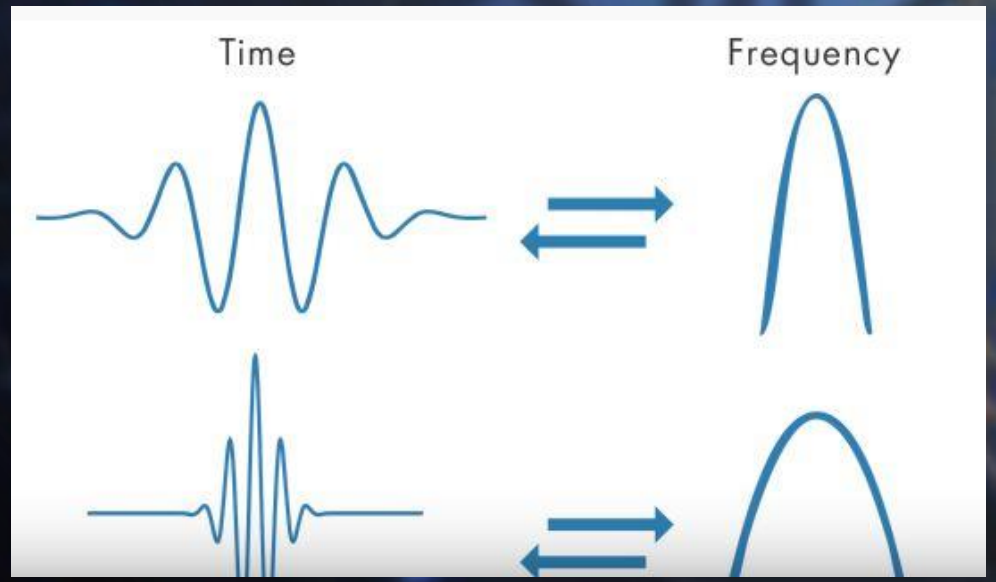


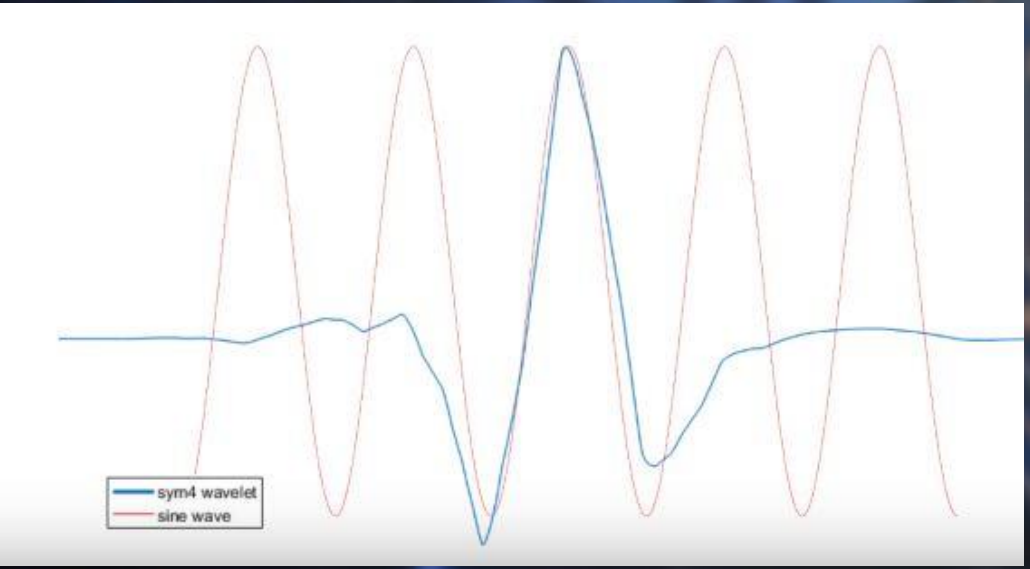
FIG: WAVELET AND FREQUENCY

WAVELET SCALE	2	4	8	16
EQUIVALENT FREQ (F_{EQ})	$\frac{F_{eq}}{2}$	$\frac{F_{eq}}{4}$	$\frac{F_{eq}}{8}$	$\frac{F_{eq}}{16}$

PHASES

PROCESSING:
TIME-FREQUENCY DOMAIN

FIG: WAVELET AND FREQUENCY



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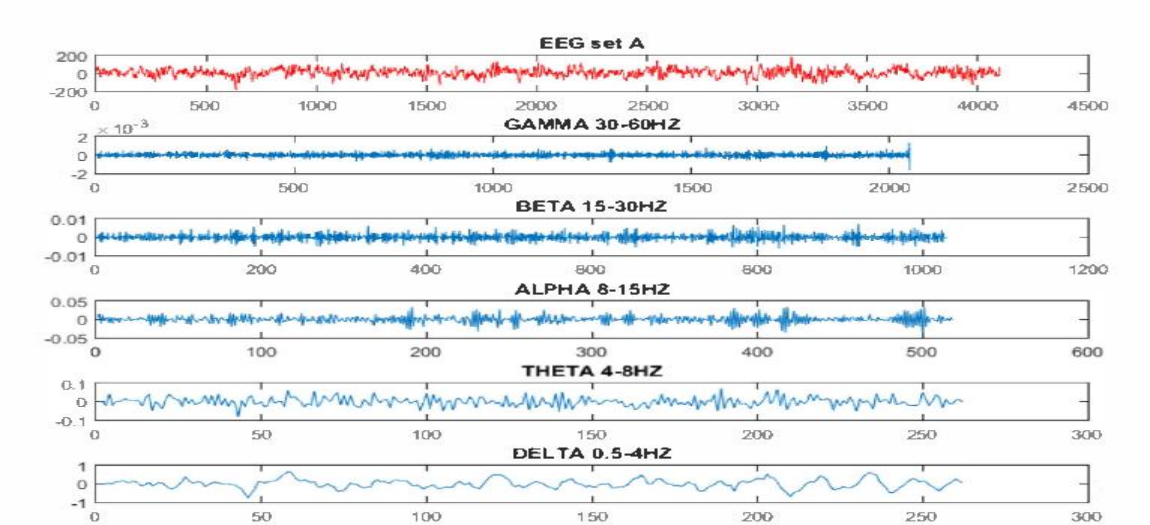


Fig. 2. Approximate and coefficients are taken from a healthy subject (set A).

PHASES

PROCESSING:
TIME-FREQUENCY DOMAIN

FIG: WINDOW FUNCTION

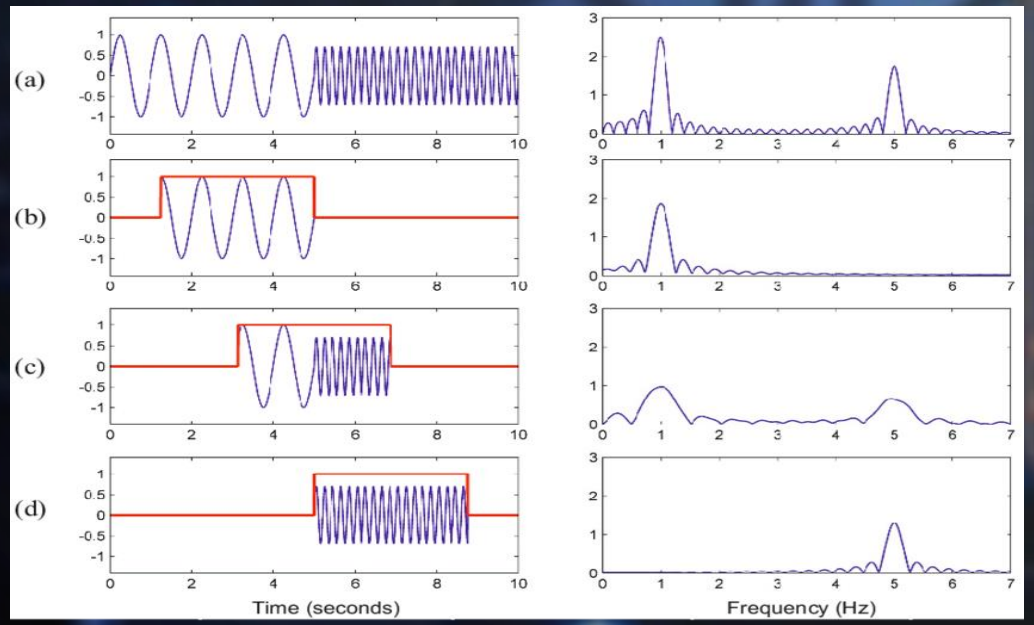
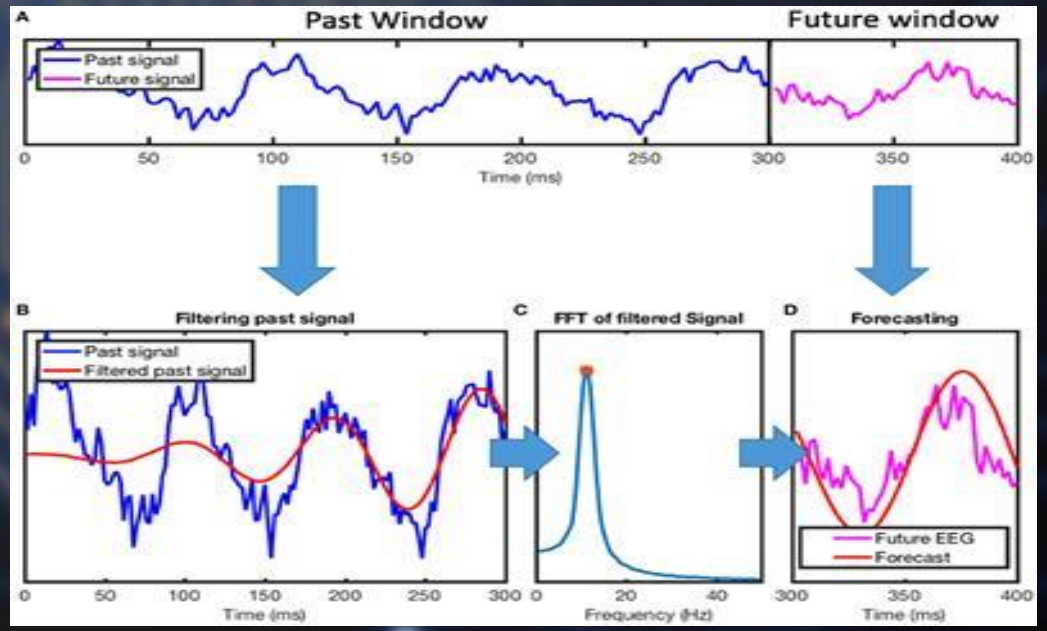
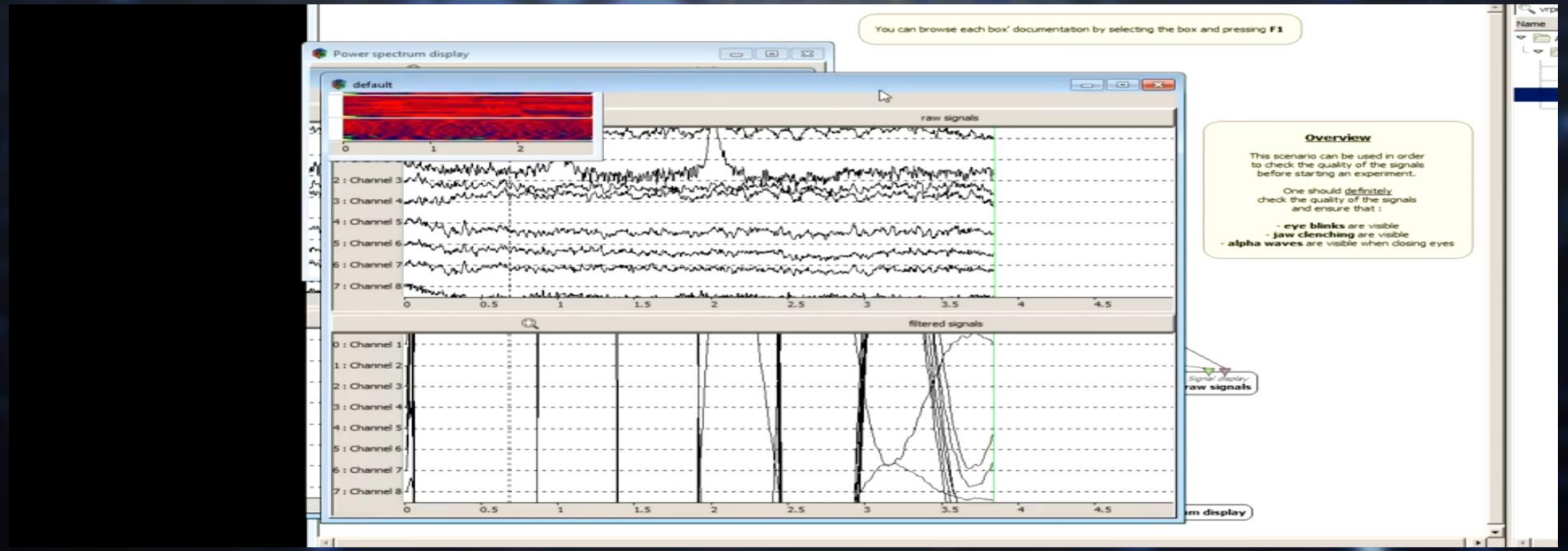


FIG: WINDOW FORECAST



PHASES

INTEFACING



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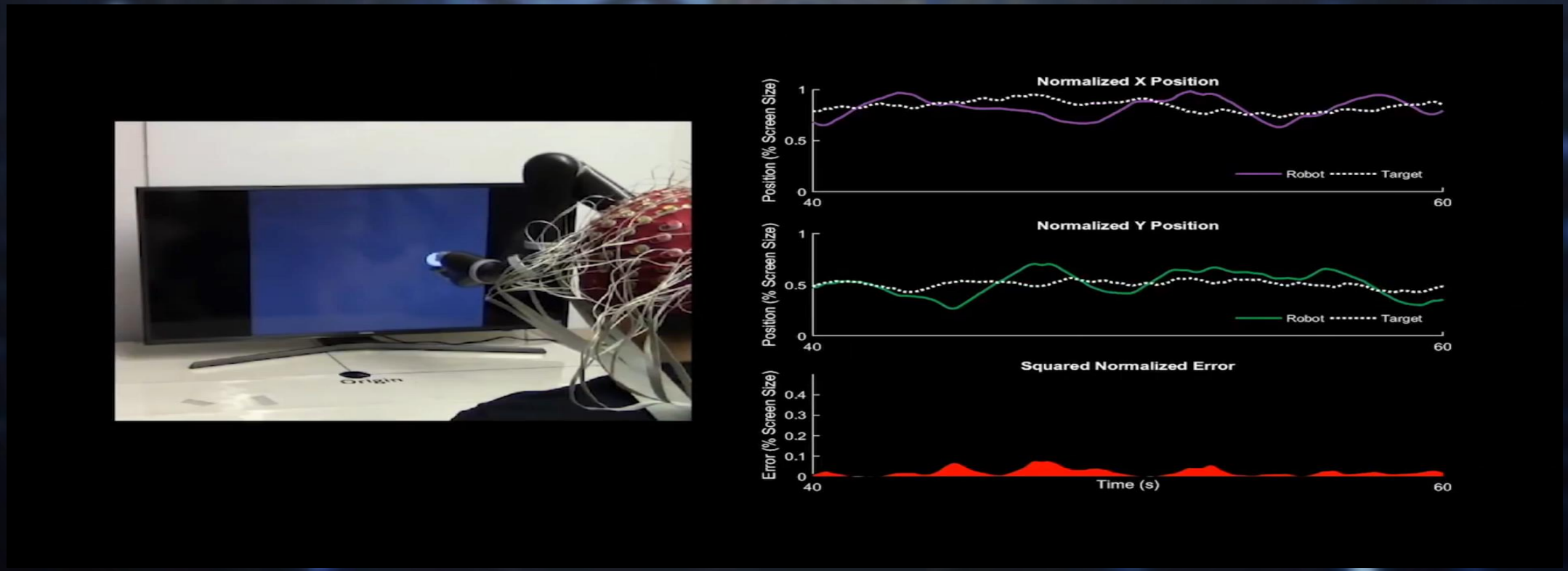

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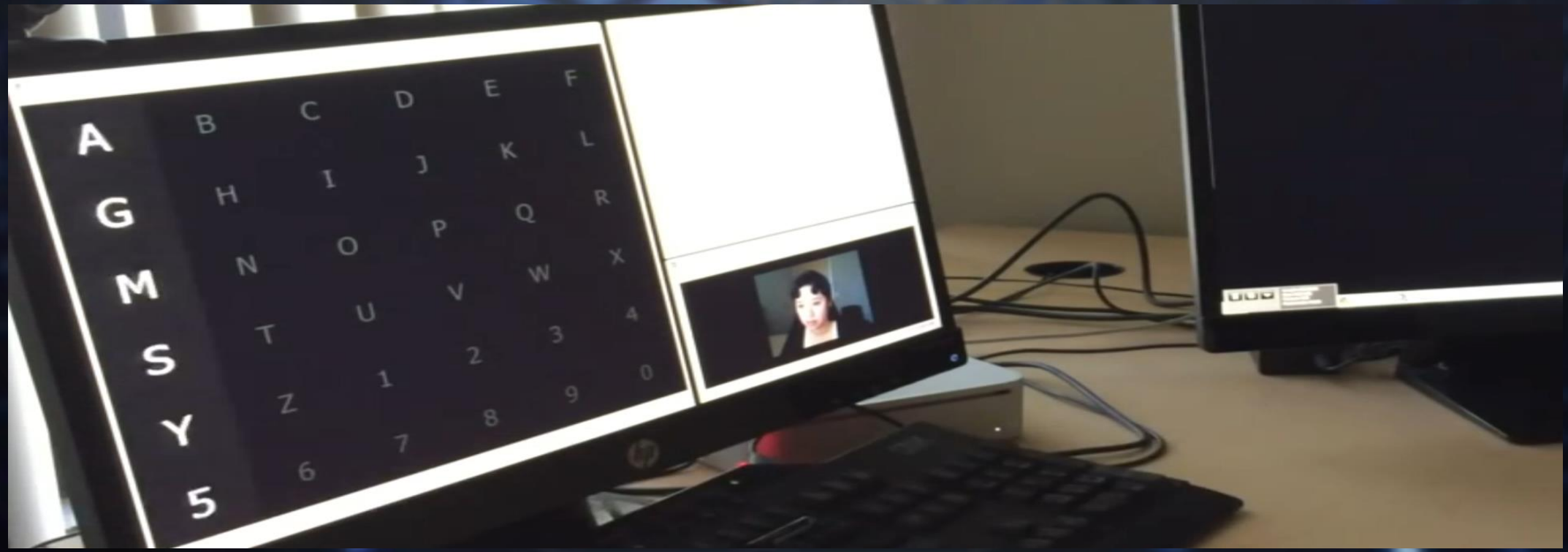

PHASES

INTEFACING

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QUESTIONS?


THANK YOU