

BRAIN-COMPUTER INTERFACE

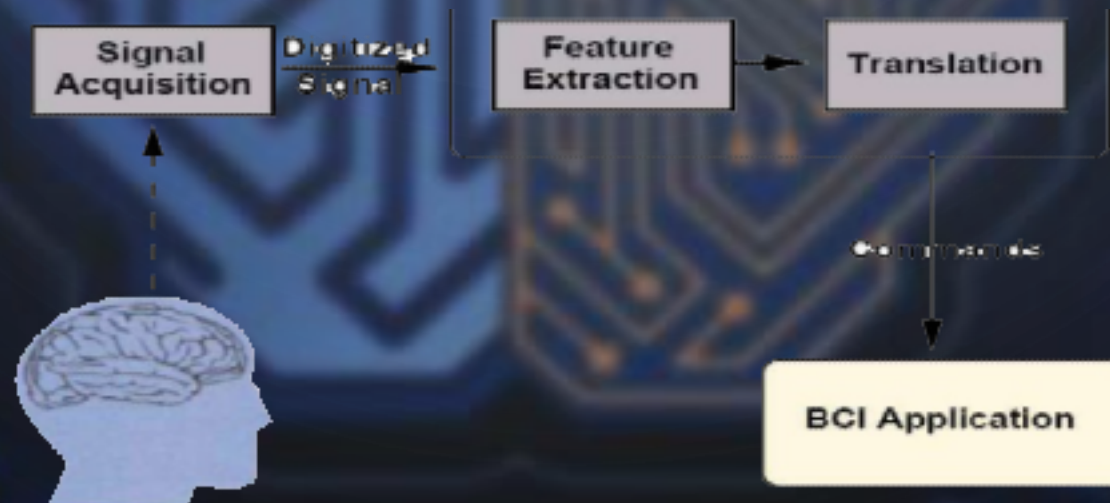
The background features a dark blue field filled with numerous small, glowing white and blue particles, resembling a starry sky or a digital data stream. Overlaid on this are faint, light blue circuit lines and nodes, some of which form a larger, stylized brain shape in the center. The brain is composed of intricate, interconnected lines and nodes, giving it a high-tech, digital appearance. The overall aesthetic is futuristic and technological.

PRESENTATION BY: SAHAJ SHAKYA

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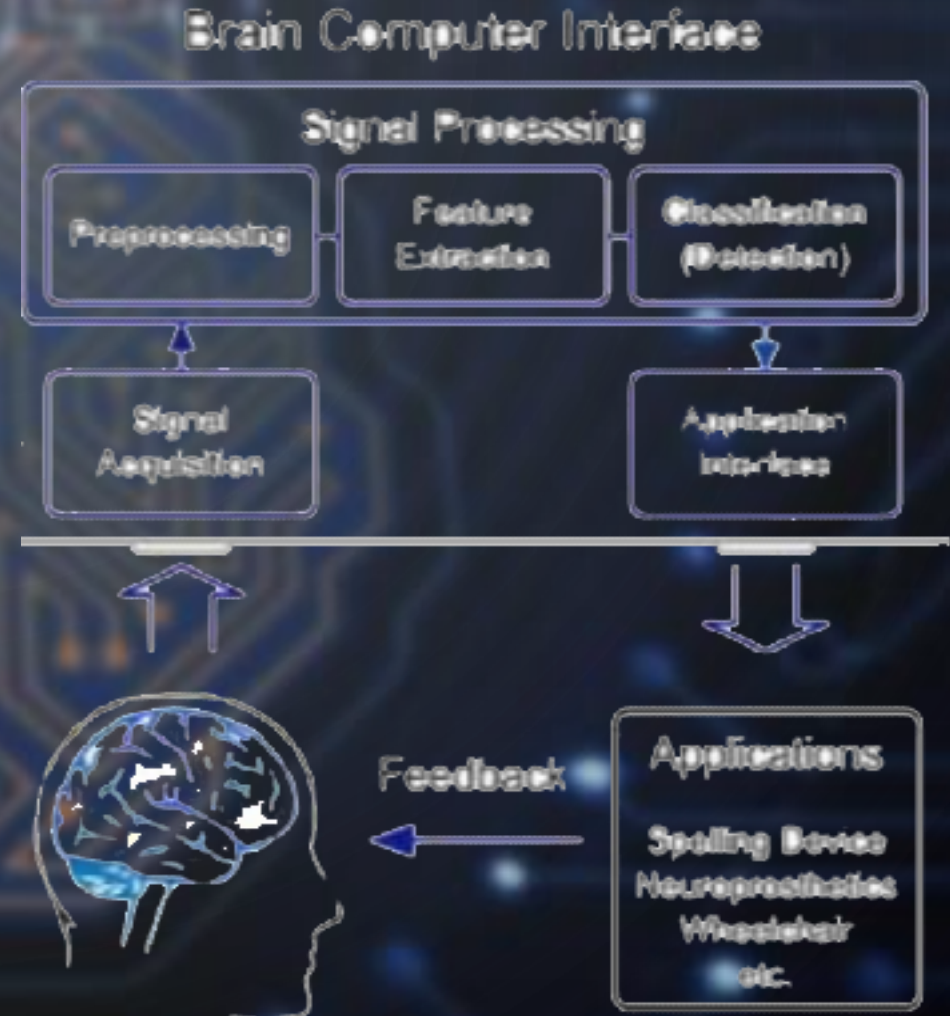
INTRODUCTION:

- 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.



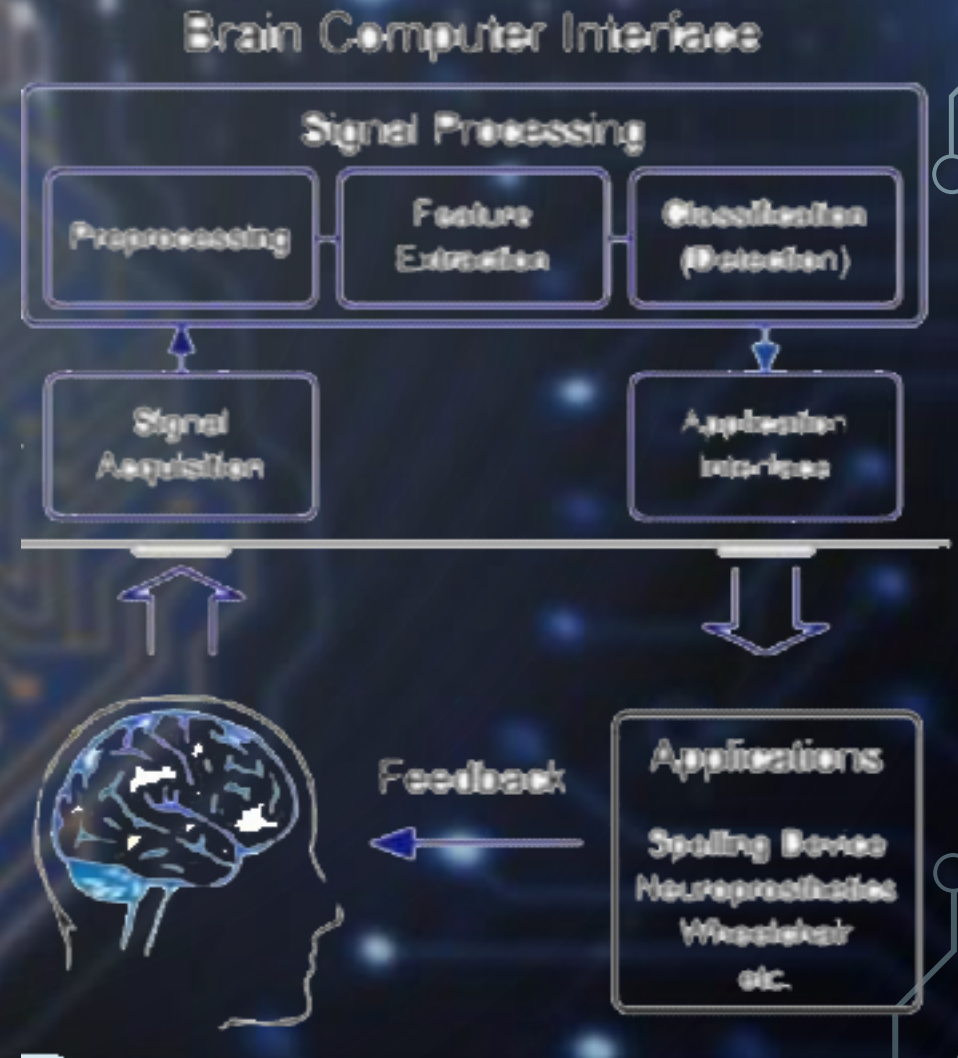
BASIC COMPONENTS:

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



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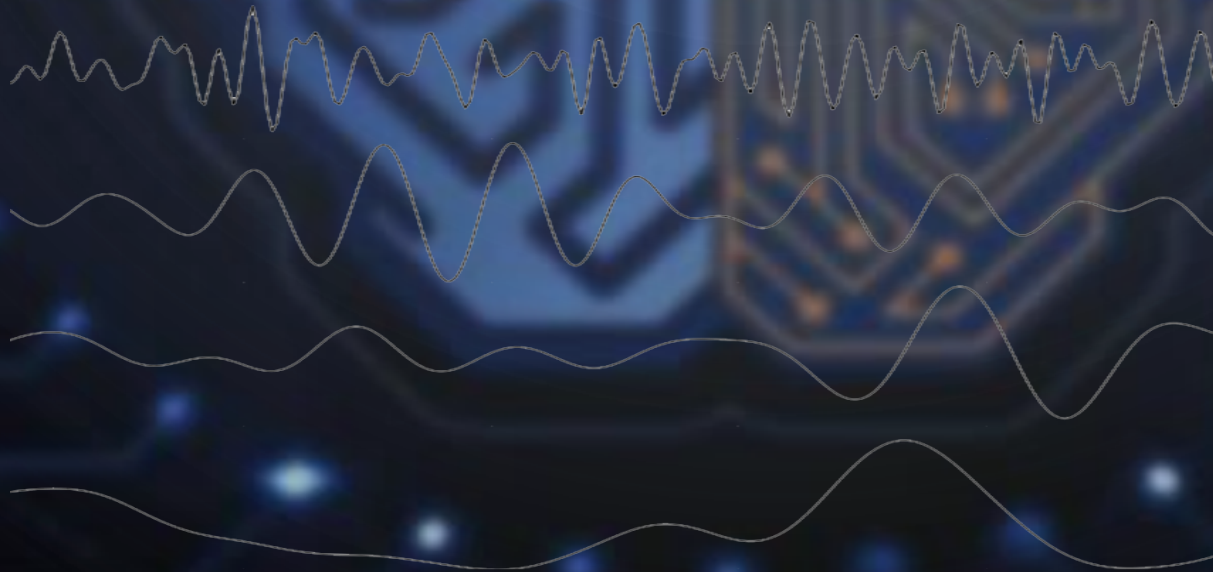
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SIGNALS IN BCI

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.



BETA WAVES

12hz - 38hz
Wide awake.

ALPHA WAVES

8hz - 12hz
Awake but relaxed
and not processing
much information.

THETA WAVES

3hz - 8hz
Light sleep or
extreme relaxation.

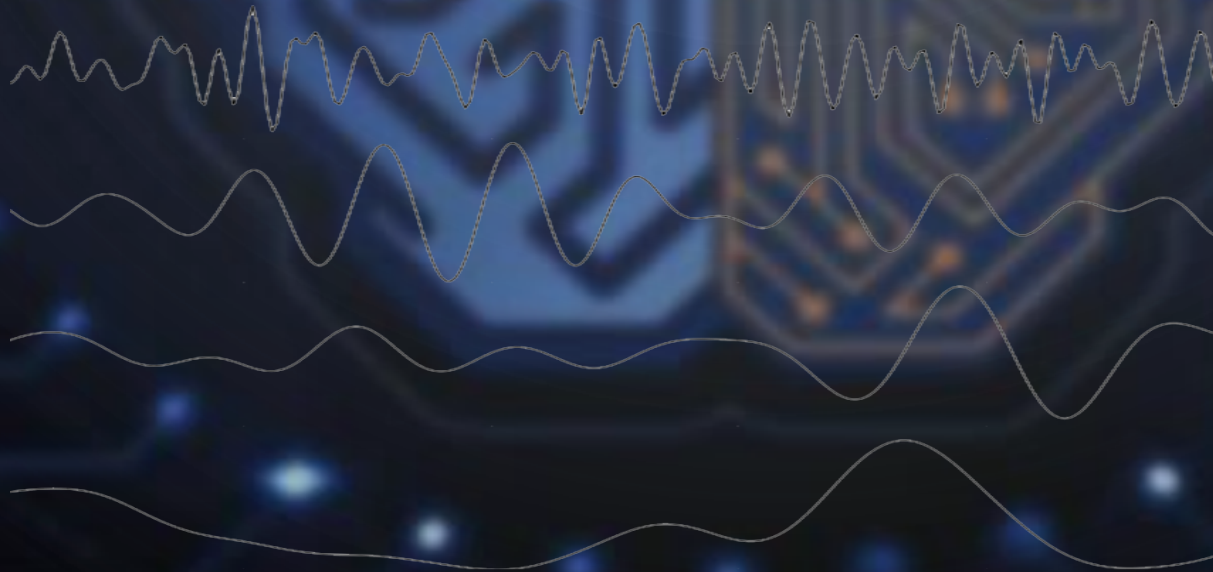
DELTA WAVES

0.2hz - 3hz
Deep, dreamless
sleep.

SIGNALS IN BCI

2. Theta (4-7)

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



BETA WAVES

12hz - 38hz
Wide awake.

ALPHA WAVES

8hz - 12hz
Awake but relaxed
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THETA WAVES

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Light sleep or
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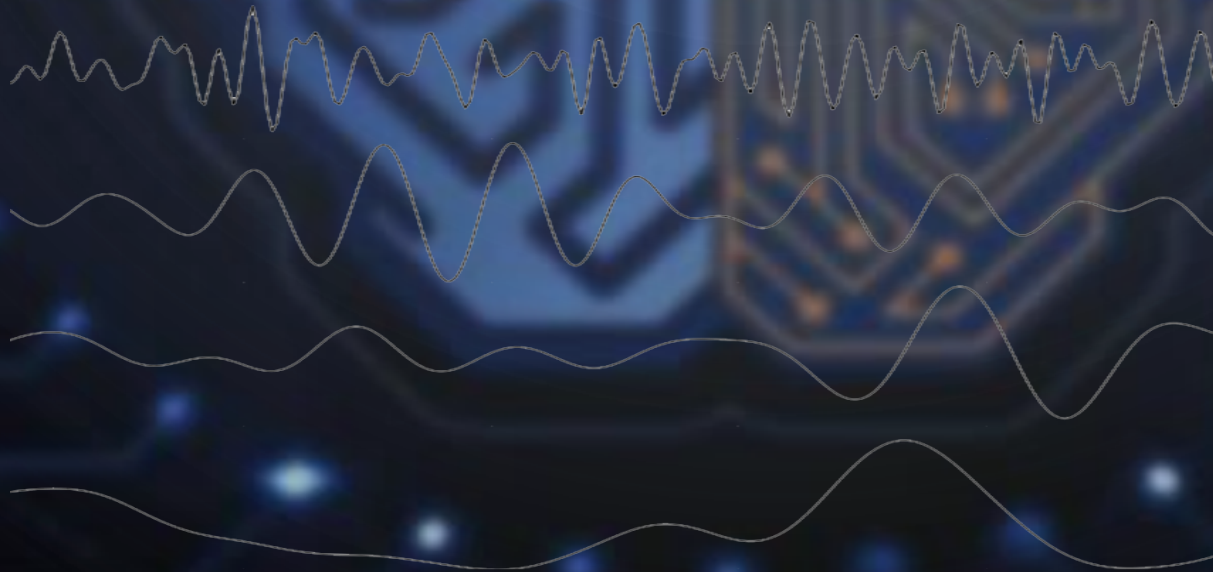
DELTA WAVES

0.2hz - 3hz
Deep, dreamless
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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.



BETA WAVES

12hz - 38hz
Wide awake.

ALPHA WAVES

8hz - 12hz
Awake but relaxed
and not processing
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THETA WAVES

3hz - 8hz
Light sleep or
extreme relaxation.

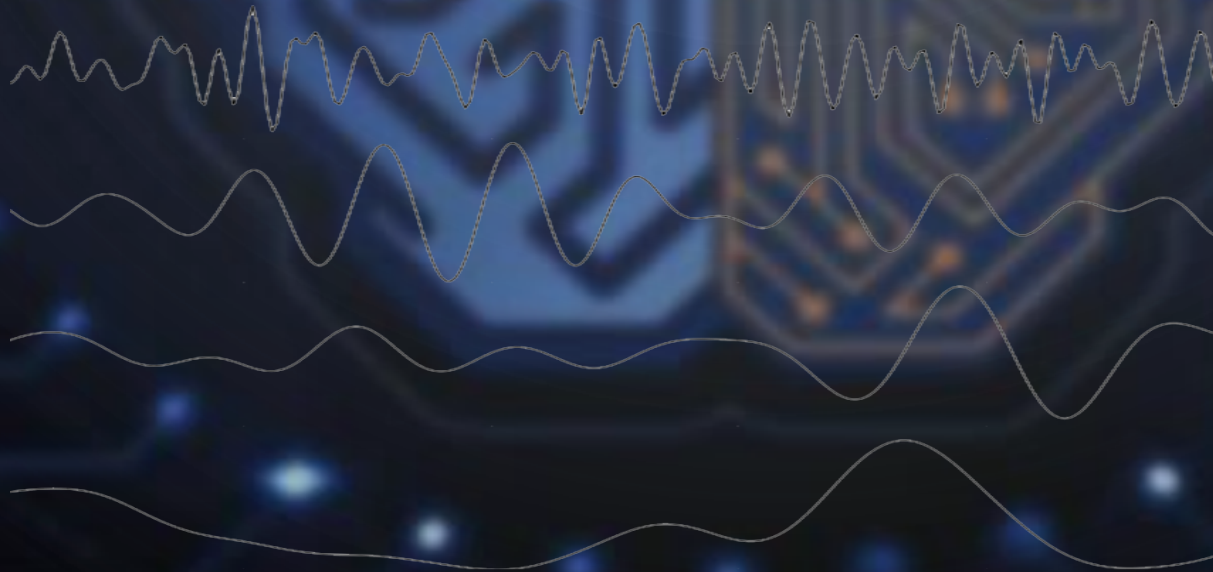
DELTA WAVES

0.2hz - 3hz
Deep, dreamless
sleep.

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.



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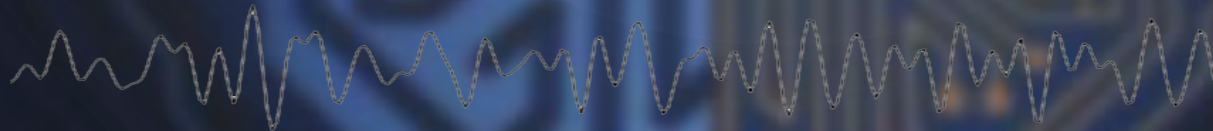
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BETA WAVES

12hz - 38hz
Wide awake.

5. Gamma(30-100)

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



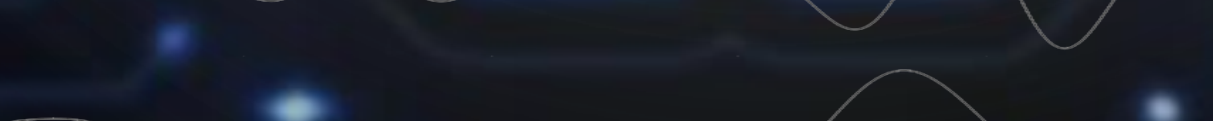
ALPHA WAVES

8hz - 12hz
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THETA WAVES

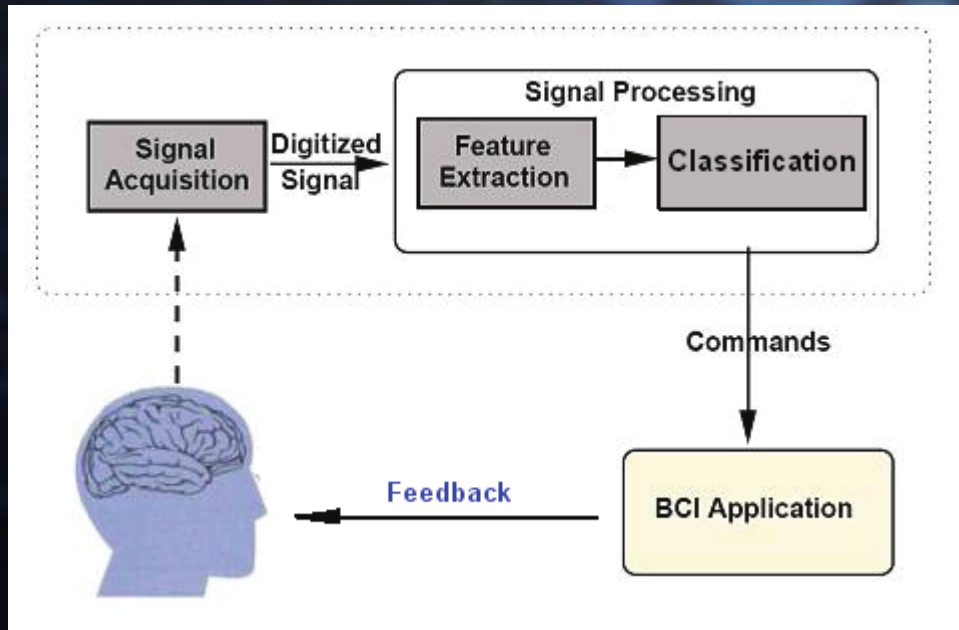
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DELTA WAVES

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Deep, dreamless
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PHASES

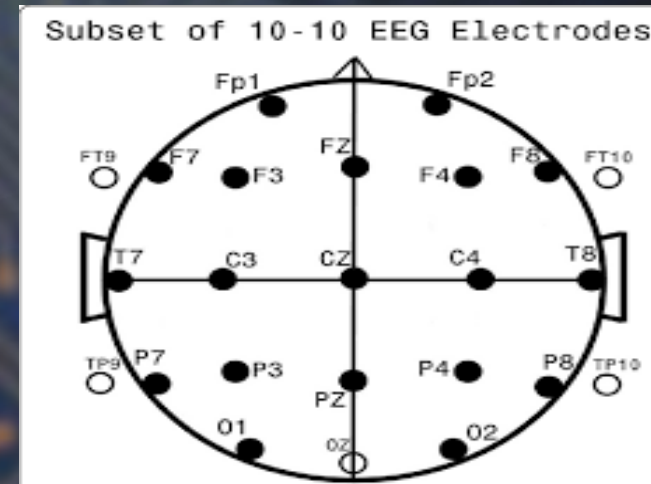


- Extraction
- Processing
- Interfacing

PHASES

EXTRACTION:

- Electrode Position
- Locate reference Electrode (eg: EEG_A are Fp1 and Fp2)
 - $\text{EEG}(\text{Fp1}) = V(\text{Fp1}) + \text{Noise}$
 - $\text{EEG}(\text{Fp2}) = V(\text{Fp2}) + \text{Noise}$
- Calculate the Potentials
 - $\text{EEG}_A = \text{EEG}(\text{Fp1}) - \text{EEG}(\text{Fp2}) = V(\text{Fp1}) - V(\text{Fp2})$



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

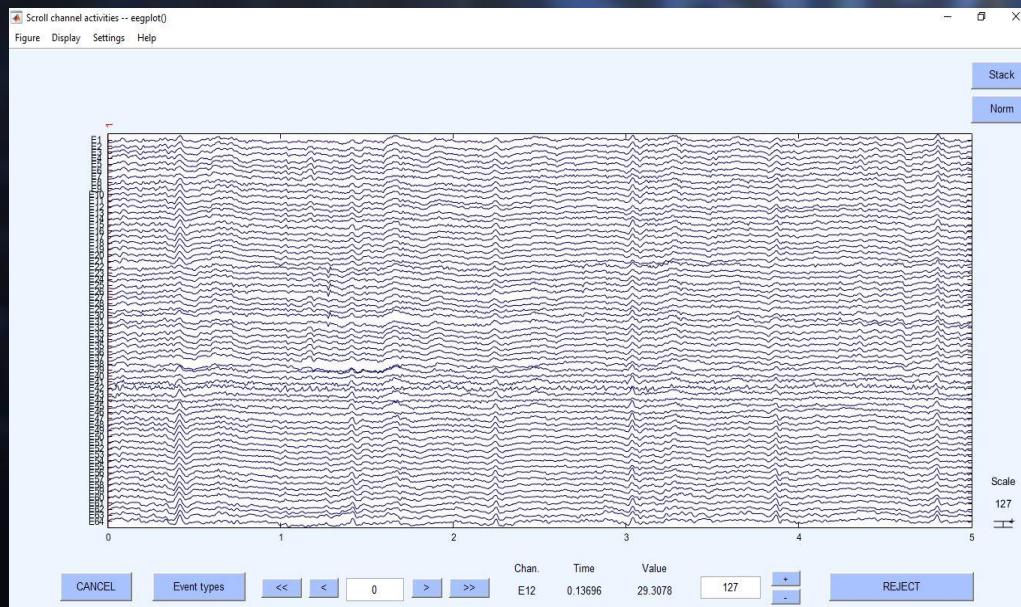
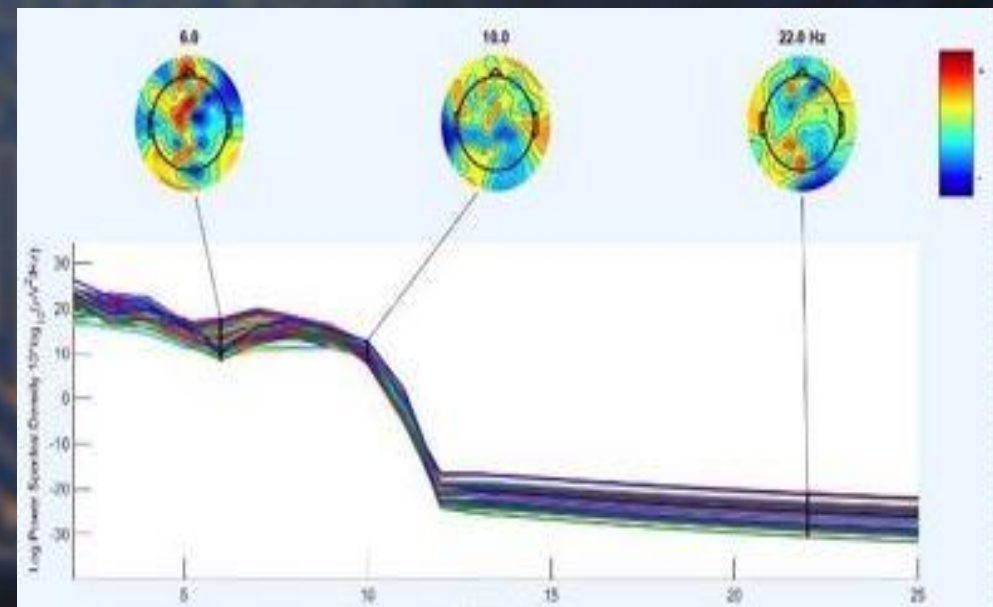


FIG: POWER SPECTRAL



PHASES

PROCESSING:
TIME-FREQUENCY DOMAIN

FIG: RAW DATA

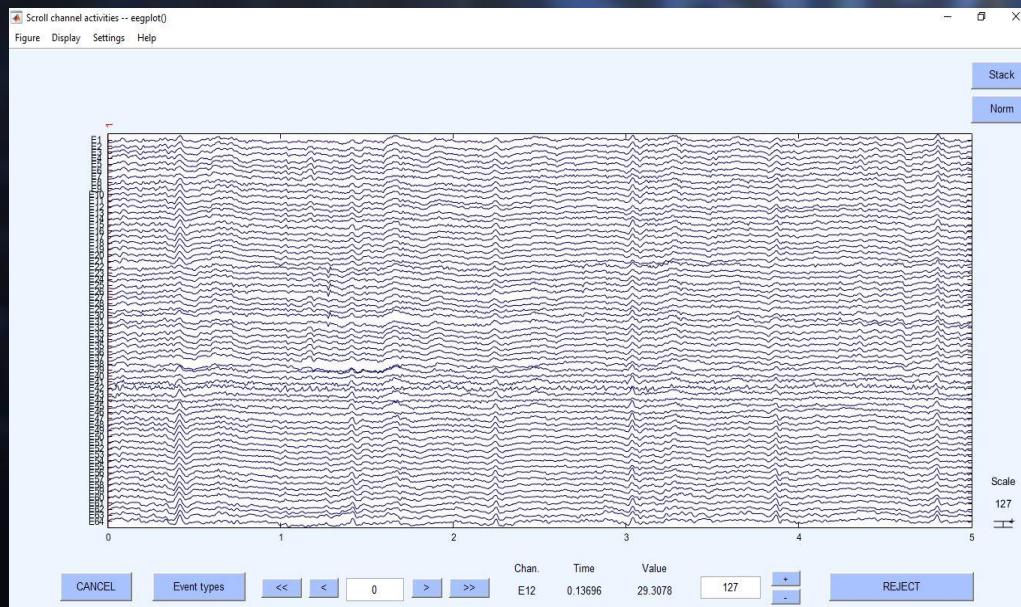
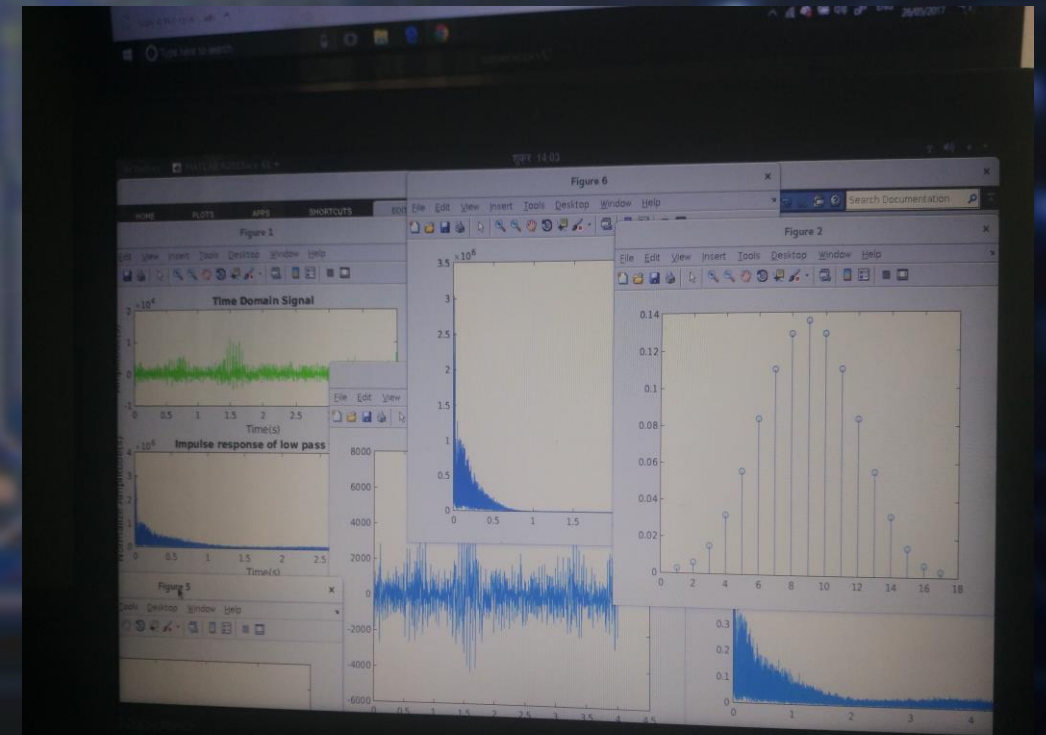


FIG: TIME-FREQUENCY
REPRESENTATION



PHASES

PROCESSING:
TIME-FREQUENCY DOMAIN

FIG: WAVELET

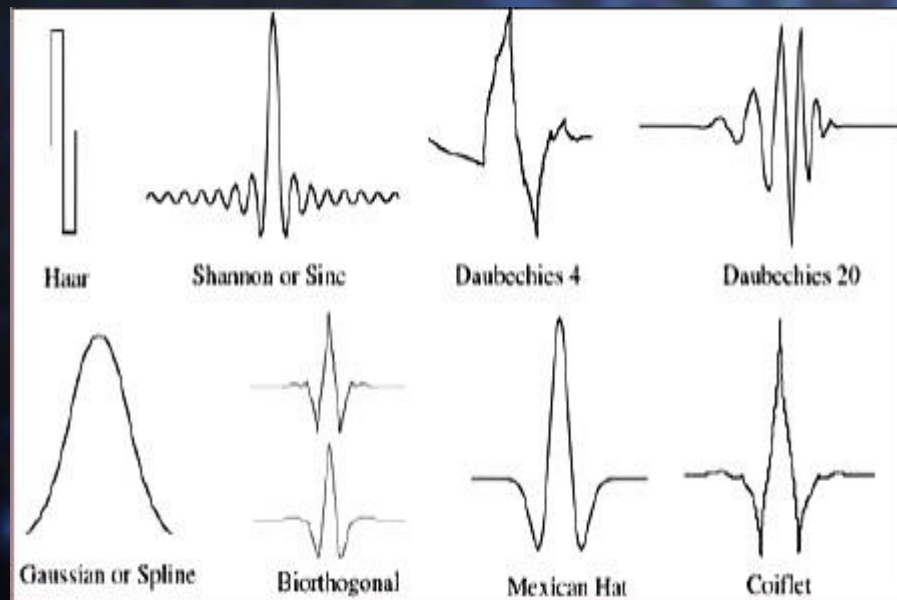
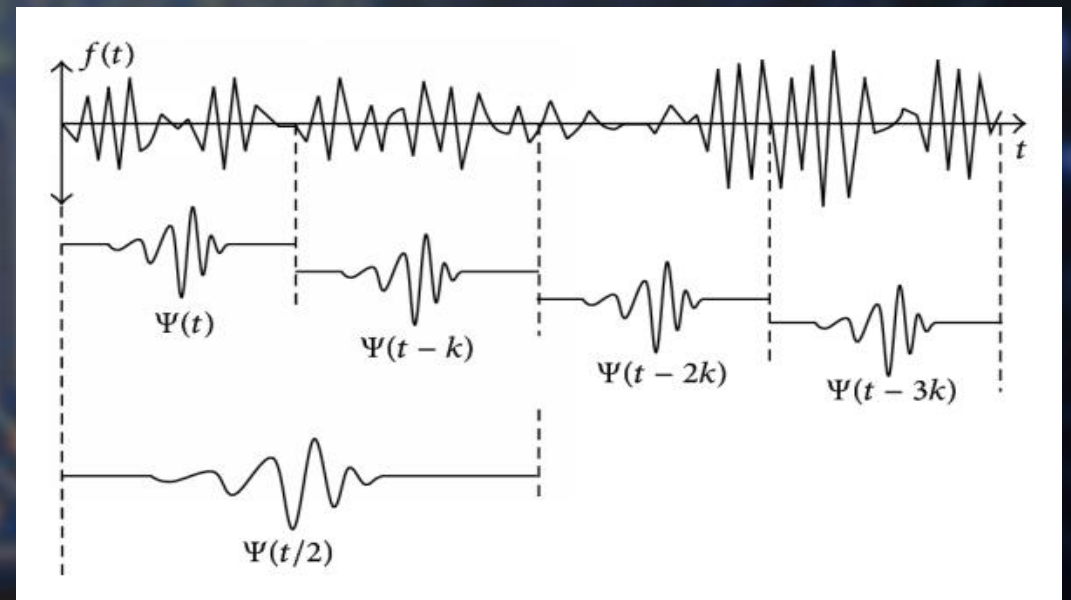


FIG: SHIFING AND SCALING



PHASES

PROCESSING:
TIME-FREQUENCY DOMAIN

FIG: WAVELET AND FREQUENCY

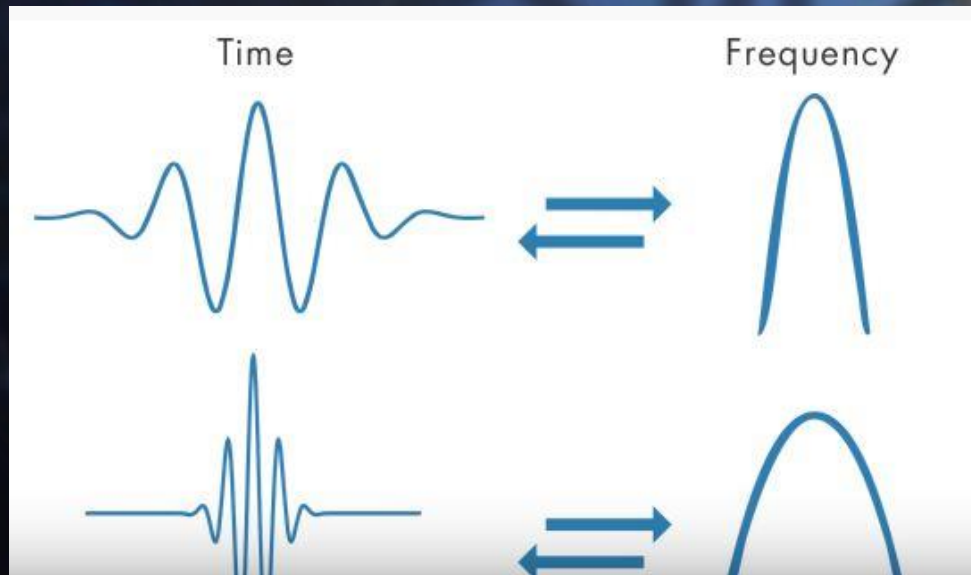


FIG: WAVELET AND FREQUENCY

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

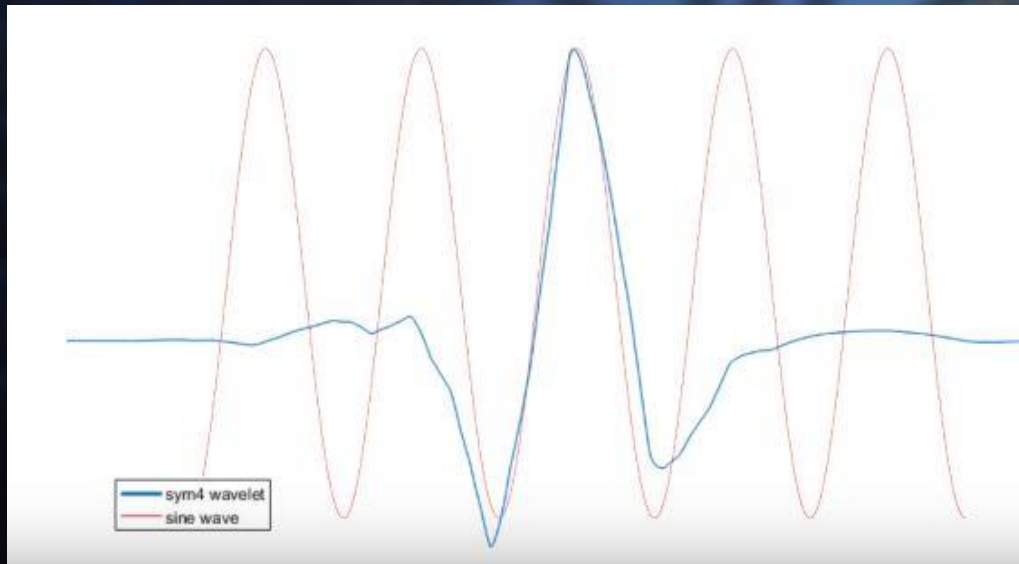
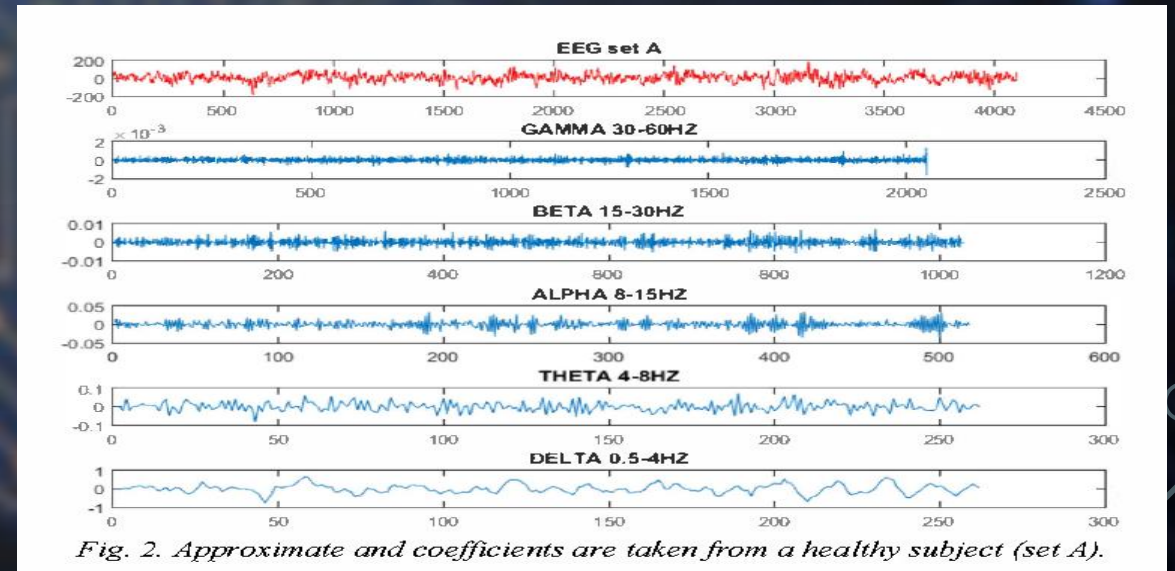


FIG: WAVELET AND FREQUENCY



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PROCESSING:
TIME-FREQUENCY DOMAIN

FIG: WINDOW FUNCTION

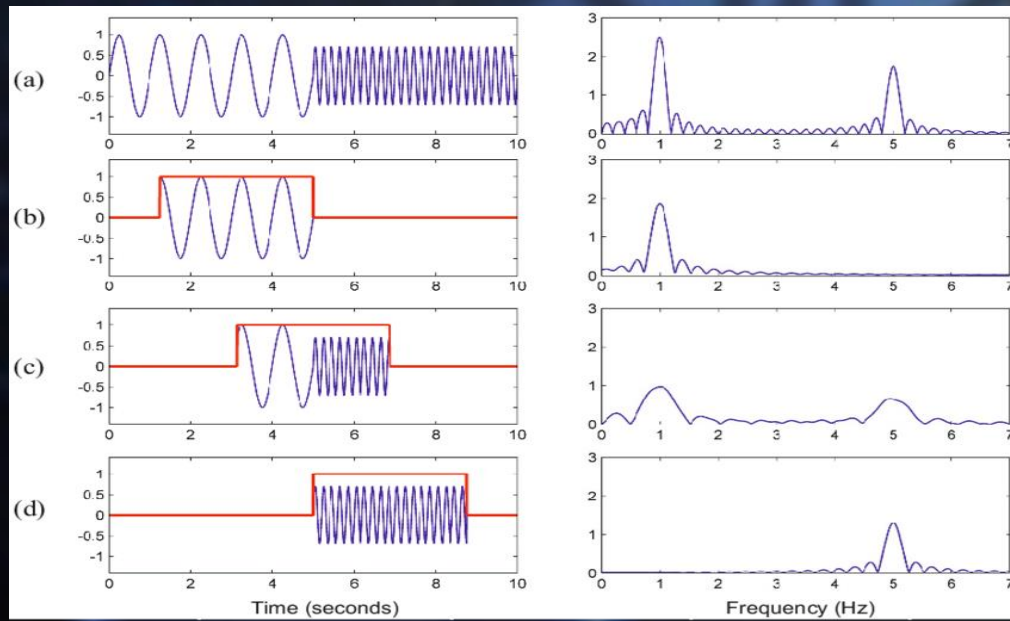
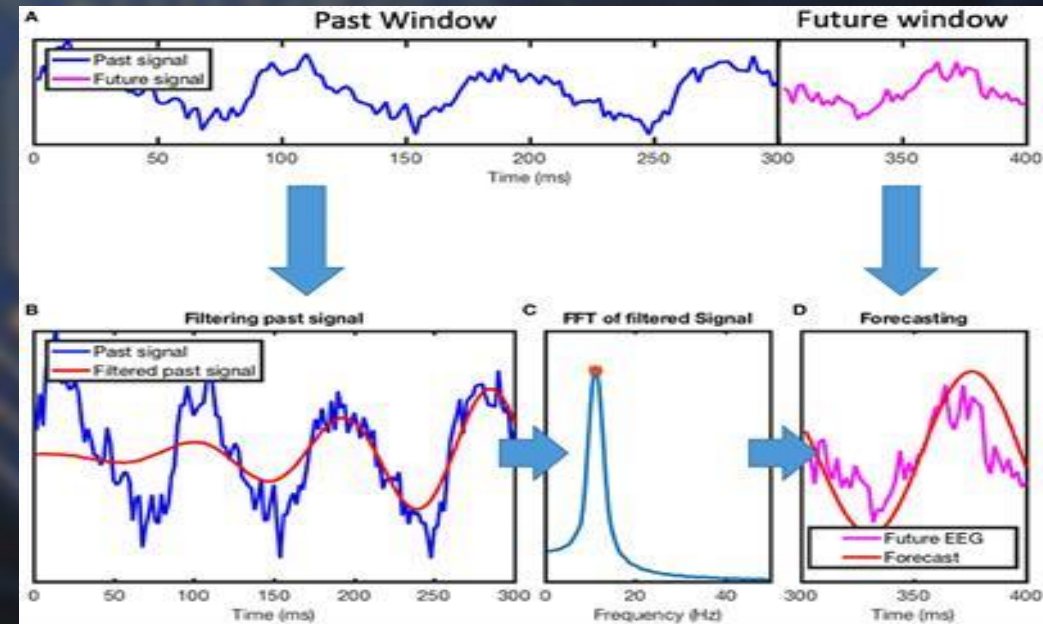
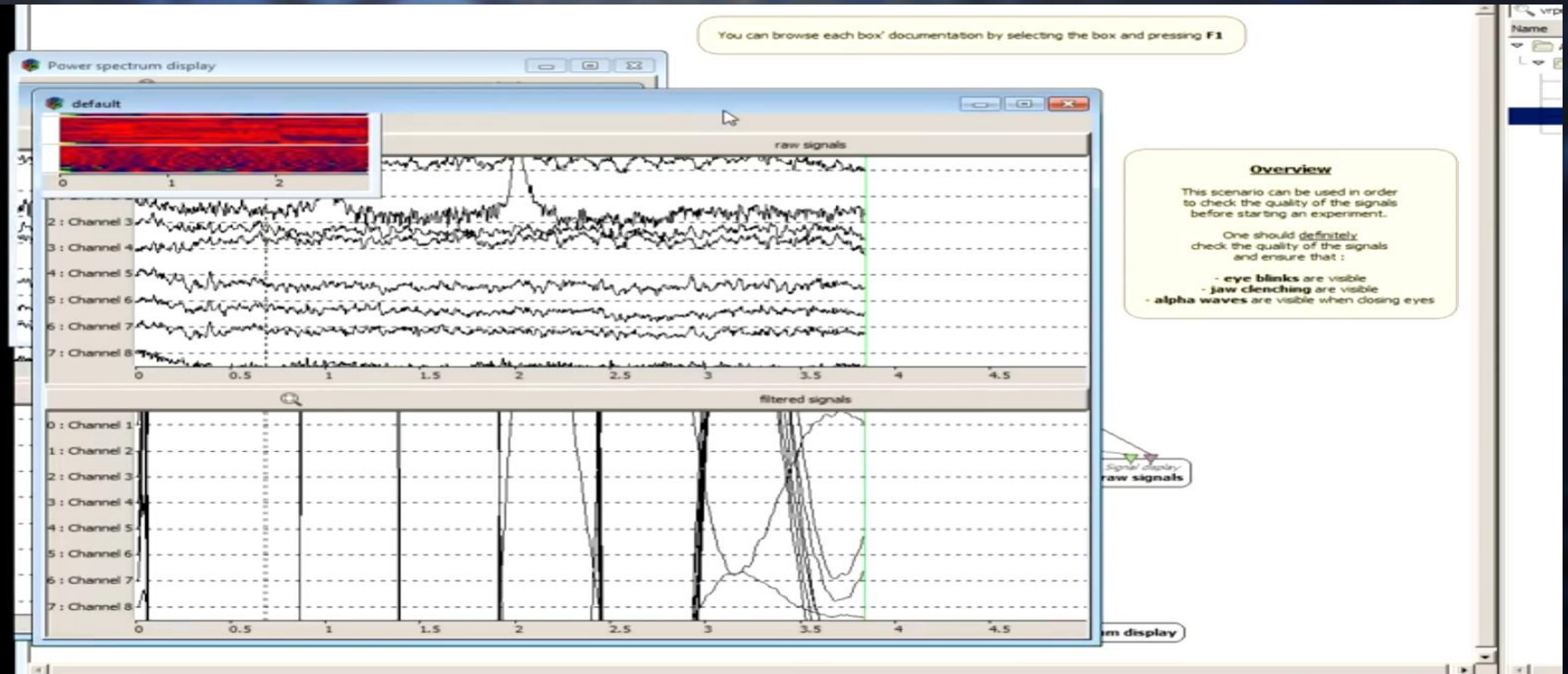


FIG: WINDOW FORECAST



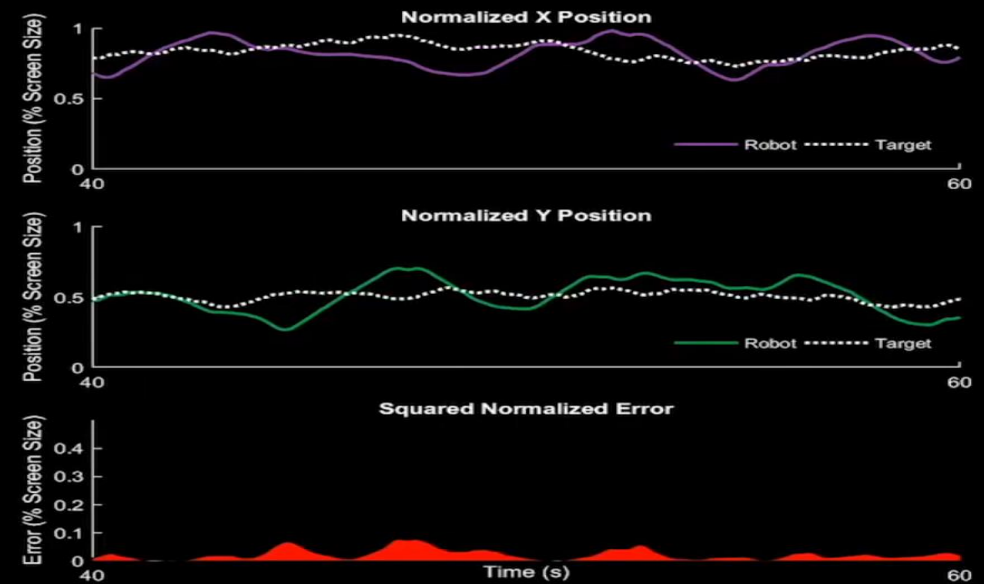
PHASES

INTERFACING



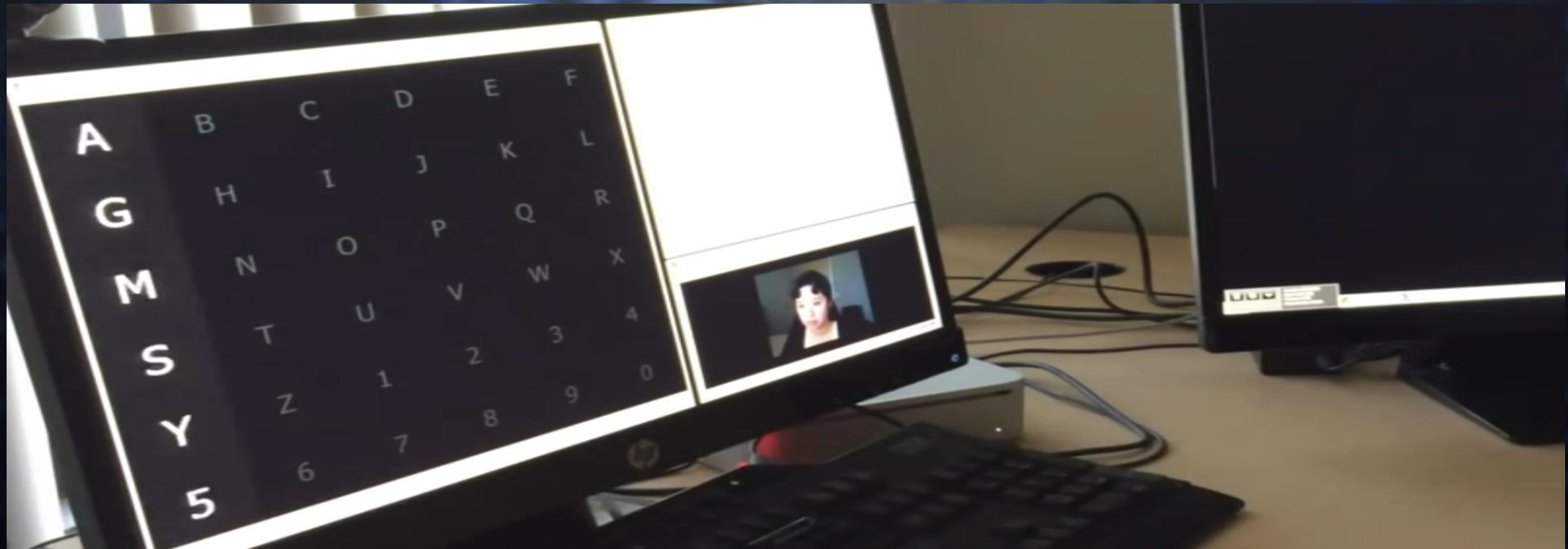
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PHASES

INTERFACING



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The background is a dark blue field filled with numerous small, bright blue and white particles, resembling a starry sky or a digital data stream. Overlaid on this are faint, light blue circuit lines that branch out from the edges towards the center. In the center of the image is a large, stylized brain. The brain is composed of intricate circuitry, with the left hemisphere (viewer's left) showing more complex, interconnected patterns, and the right hemisphere (viewer's right) showing more linear, parallel circuit paths. The word "QUESTIONS?" is centered over the brain in a large, white, bold, sans-serif font.

QUESTIONS?

The background is a dark blue field filled with numerous small, glowing white and light blue particles, resembling a starry sky or a data stream. Overlaid on this are faint, light blue circuit lines that branch out from the corners towards the center. In the center of the image is a large, stylized brain shape. The brain is composed of intricate, glowing circuitry patterns in shades of blue and white, with some orange-yellow highlights. The text "THANK YOU" is centered over the brain.

THANK YOU