Heaven's light is our guide

RAJSHAHI UNIVERSITY OF ENGINEERING AND TECHNOLOGY

Department Of Electrical & Computer Engineering

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ECE 4144

Experiment No. 2

Analysis of an Electroencephalogram (EEG) Signal

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Name of the Experiment

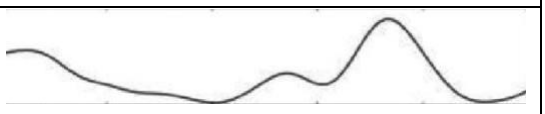
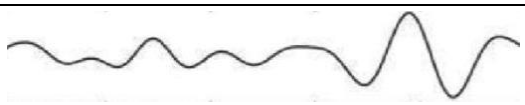
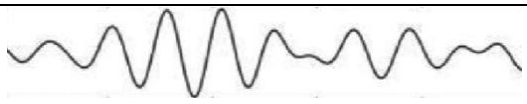
Analysis of an Electroencephalogram (EEG) Signal.

Objective

- Investigate EEG signal composition and characteristics.
- Identify types of brain waves (alpha, beta, delta, theta).
- Analyze EEG data from an open-source dataset due to unavailable recording tools.

Theory

EEG (Electroencephalography) is a non-invasive technique for monitoring brain activity via electrodes placed on the scalp. These signals, recorded in microvolts, reflect the combined neuronal activity and fall into several frequency bands:

Band	Frequency Range	Typical Mental State	Example of Filtered Bandwidth
Delta (δ)	0.5 – 4 Hz	Deep sleep, unconsciousness	
Theta (θ)	4 – 8 Hz	Drowsiness, meditation, light sleep, cognitive load	
Alpha (α)	8 – 13 Hz	Relaxation, calm alertness, eyes closed	
Beta (β)	13 – 30 Hz	Active thinking, attention, problem solving	
Gamma (γ)	30 – 100 Hz	High-level cognition, perception, consciousness	

Electrodes follow the 10-20 International System, with labels indicating brain regions: Fp (prefrontal), F (frontal), C (central), T (temporal), P (parietal), and O (occipital).

Experimental Observation

Using PhysioNet EEG datasets, we examined signals from locations like Fp1, Fp2, C3, C4, O1, and O2. Each wave type reflected specific mental states: alpha during relaxation and beta during concentration. Data was pre-recorded; no live recordings were conducted.

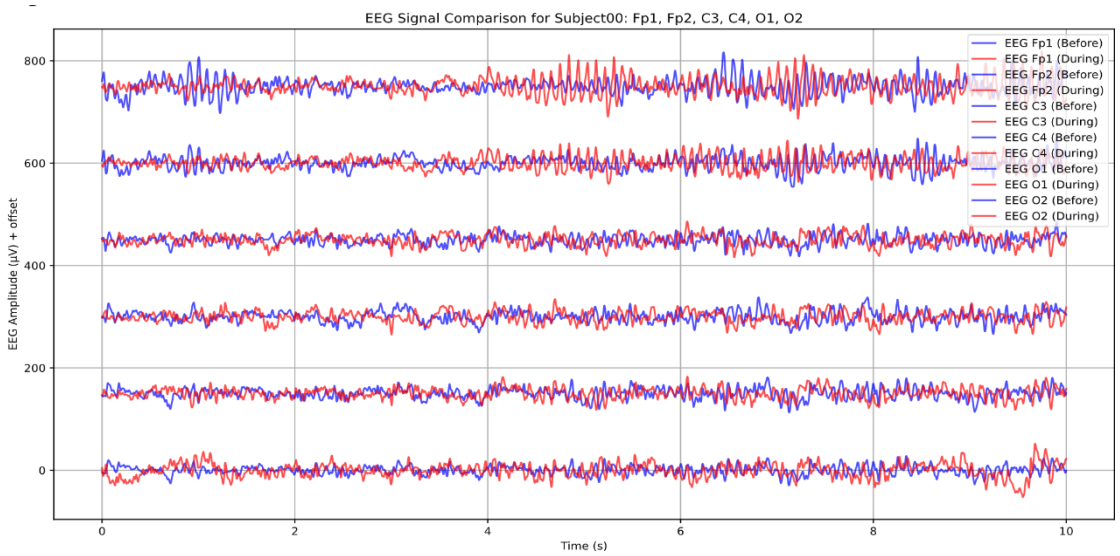


Figure 1: A diagram of EEG signal in different frequencies.

Discussion and Conclusion

Despite not using real-time EEG equipment, the study effectively introduced EEG analysis through authentic datasets. We learned to recognize signal patterns, interpret brainwave frequencies, and understand electrode placements. The experiment clarified how mental states influence EEG signals, reinforcing core concepts of brain activity analysis.

References:

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3. PhysioNet, "EEG Motor Movement/Imagery Dataset," PhysioNet, 2019. [Online]. Available: https://physionet.org/content/eegmmidb/1.0.0/