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Analysis of Brain Wave Variability across Different Cognitive Tasks using EEG-Based BCI Systems

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Abstract: *Brain-Computer Interface systems have gained significant attention in neuroscience and neuroengineering due to their ability to interpret brain activity and translate it into actionable commands. Electroencephalography provides a non-invasive, cost-effective method to capture brain wave variability associated with cognitive tasks such as attention, memory, and problem-solving. This review explores the patterns of brain wave variability across various cognitive tasks using EEG-based BCI systems, highlighting the role of frequency bands in task-specific neural responses. Findings suggest that cognitive load, task complexity, and individual differences significantly affect EEG signal characteristics, with implications for adaptive BCI design, neurofeedback, and cognitive assessment tools.*

Keywords*:* Cognitive Tasks, Brain Wave Variability, Neural Oscillations