

Classification of RF-Induced Brainwave Alterations Using SVM: An EEG Study on Neural Asymmetry in High Frequency Bands

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Abstract:

With increasing concerns about the potential effects of radiofrequency (RF) exposure on brain activity due to mobile phones, an in-depth exploration is imperative. This study harnesses Support Vector Machines (SVM) as a robust machine learning tool to accurately classify brain states influenced by RF exposure, focusing on alpha and beta neural signals. The primary aim is to uncover distinct brainwave patterns induced by RF exposure, correlating neural signals with asymmetry scores through advanced feature extraction, and developing an intelligent classification technique using SVM. This study analyses Electroencephalography (EEG) data from 102 engineering students at Universiti Teknologi MARA (UiTM), including both males and females, exposed to three types of RF exposure (Left Exposure (LE), Right Exposure (RE), and Sham Exposure (SE)) across three sessions (before, during, and after). Using Fast Fourier Transform (FFT), the signals were converted into Power Spectral Density (PSD) data and grouped into respective brainwave frequency bands. In order to standardize the brain signals and make it easier to compute the Power Asymmetry Ratio (PAR), which measures disparities in signal strength between the hemispheres, data normalization was applied. Discriminant and classification analysis using SVM were used to distinguish the brainwave signals across three exposure types and sessions. According to the results, the SVM classifier was able to distinguish between various brain states. The 70:30 data split had the best training set accuracy (80.88%) and test set accuracy (71.43 %) for the session. This finding strongly suggested that both beta and alpha brainwaves are significantly affected by RF exposure. Beta waves showed a delayed increase in after exposure asymmetry for LE and an immediate increase during exposure in RE. Alpha waves exhibited a significant increase in LE, indicating specific lateralized relaxation effects. This research highlights the effects of RF expo...

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