

Intelligent Instrumentation for EEG Signal Monitoring Using Adaptive Noise Reduction Techniques

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Abstract: *Electroencephalography (EEG) is an important biomedical instrumentation technique used to record electrical activity generated by the human brain. EEG signals are characterized by low amplitude and are highly vulnerable to physiological, environmental & instrumental noise. Eye movements, muscle activity, electrode displacement, power-line interference and baseline fluctuations can significantly affect quality of EEG recordings. This proposes an intelligent instrumentation framework for EEG signal monitoring using adaptive noise reduction techniques. Proposed system integrates EEG electrodes, instrumentation amplification, analog conditioning, digital signal processing, adaptive filtering and intelligent signal-quality assessment. Least Mean Square (LMS), Normalized LMS (NLMS) and Recursive Least Squares (RLS) algorithms are considered for dynamic noise suppression while wavelet-based processing is incorporated to preserve non-stationary EEG characteristics. Proposed framework can be evaluated using signal-to-noise ratio, root mean square error, correlation coefficient, artifact attenuation and computational complexity. This provides a foundation for reliable and potentially real-time EEG monitoring systems.*

Keywords: EEG, Intelligent Instrumentation, Adaptive Filtering, Noise Reduction & Signal Monitoring