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Electroencephalography Simulation Hardware for Realistic Seizure, Preseizure and Normal Mode Signal Generation

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Abstract:

Unlike the ECG and EKG simulators which are very commonly used for these applications, there is a big need for seizure related EEG simulator. Having a hardware system that can be used instead of a real patient to generate realistic EEG signals is still in research phase. Here a framework is presented that can be used to realize EEG simulator in a pseudo-embedded form. This implies that the analog output depends on real patient data. The proposed hardware simulator will enhance researchers and hardware validators to simulate, validate and test their detection algorithms forehand, as well as for clinicians to use this system for training as well as for academic exercises. By utilizing significant spectral contents of real patient data, a simulated signal can be reproduced any time and can be modified for the seizure and pre-seizure cases by utilizing the model coefficients identified through standard ARMA system identification technique. A novel work has been done in producing simulated data based on empirical models of the real waveforms. Such a simulator will be very helpful in EEG related research since all the initial algorithms can be tuned to the controlled data first before going to the actual human subjects. Unlike the commercial ECG simulators, to the best of our knowledge, there is no such commercially available system that can be used for such research tasks. With controlled data types, healthy/normal, seizure and pre-seizure classes, tuning of algorithms for detection and classification applications can be attained. The model has been validated and tested with respect to accuracy of correct regeneration, false prediction rate, specificity, sensitivity and false detection rate.

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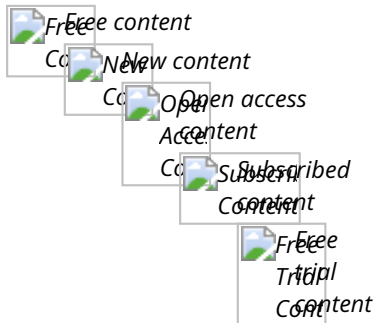
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