**Epilepsy Prodrome**

**EEG algorithm reviews**

**1**

Automated EEG analysis of epilepsy: A review; Acharya, U et al; 2013; Knowledge-Based Systems

**Abstract**

Epilepsy is an electrophysiological disorder of the brain, characterized by recurrent seizures. Electroencephalogram (EEG) is a test that measures and records the electrical activity of the brain, and is widely used in the detection and analysis of epileptic seizures. However, it is often difficult to identify subtle but critical changes in the EEG waveform by visual inspection, thus opening up a vast research area for biomedical engineers to develop and implement several intelligent algorithms for the identification of such subtle changes. Moreover, the EEG signals are nonlinear and non-stationary in nature, which contribute to further complexities related to their manual interpretation and detection of normal and abnormal (interictal and ictal) activities. Hence, it is necessary to develop a Computer Aided Diagnostic (CAD) system to automatically identify the normal and abnormal activities using minimum number of highly discriminating features in classifiers. It has been found that nonlinear features are able to capture the complex physiological phenomena such as abrupt transitions and chaotic behavior in the EEG signals. In this review, we discuss various feature extraction methods and the results of different automated epilepsy stage detection techniques in detail. We also briefly present the various open ended challenges that need to be addressed before a CAD based epilepsy detection system can be set-up in a clinical setting.

**2**

EEG seizure detection and prediction algorithms: a survey; Alataiby, Turkey N et al; 2014; EURASIP Journal on Advances in Signal Processing

**Abstract**

Epilepsy patients experience challenges in daily life due to precautions they have to take in order to cope with this condition. When a seizure occurs, it might cause injuries or endanger the life of the patients or others, especially when they are using heavy machinery, e.g., deriving cars. Studies of epilepsy often rely on electroencephalogram (EEG) signals in order to analyze the behavior of the brain during seizures. Locating the seizure period in EEG recordings manually is difficult and time consuming; one often needs to skim through tens or even hundreds of hours of EEG recordings. Therefore, automatic detection of such an activity is of great importance. Another potential usage of EEG signal analysis is in the prediction of epileptic activities before they occur, as this will enable the patients (and caregivers) to take appropriate precautions. In this paper, we first present an overview of seizure detection and prediction problem and provide insights on the challenges in this area. Second, we cover some of the state-of-the-art seizure detection and prediction algorithms and provide comparison between these algorithms. Finally, we conclude with future research directions and open problems in this topic.

**3**

Seizure prediction for therapeutic devices: A review; Gadhoumi, Kais et al; 2016; Journal of Neuroscience Methods

**Abstract**

Research in seizure prediction has come a long way since its debut almost 4 decades ago. Early studies suffered methodological caveats leading to overoptimistic results and lack of statistical significance. The publication of guidelines addressing mainly the question of performance evaluation and statistical validation in seizure prediction helped revising the status of the field. While many studies failed to prove that above chance prediction is possible by applying these guidelines, other studies were successful. Methods based on EEG analysis using linear and nonlinear measures were reportedly successful in detecting preictal changes and using them to predict seizures above chance. In this review, we present a selection of studies in seizure prediction published in the last decade. The studies were selected based on the validity of the methods and the statistical significance of performance results. These results varied between studies and many showed acceptable levels of sensitivity and specificity that could be appealing for therapeutic devices. The relatively large prediction horizon and early preictal changes reported in most studies suggest that seizure prediction may work better in closed loop seizure control devices rather than as seizure advisory devices. The emergence of a large database of annotated long-term EEG recordings should help prospective assessment of prediction methods. Some questions remain to be addressed before large clinical trials involving seizure prediction can be carried out.

**4**

Future of seizure prediction and intervention: closing the loop; Nagaraj, V et al; 2015; Journal of Neurophysiology

**Abstract**

The ultimate goal of epilepsy therapies is to provide seizure control for all patients while eliminating side effects. Improved specificity of intervention through on-demand approaches may overcome many of the limitations of current intervention strategies. This article reviews the progress in seizure prediction and detection, potential new therapies to provide improved specificity, and devices to achieve these ends. Specifically, we discuss (1) potential signal modalities and algorithms for seizure detection and prediction, (2) closed-loop intervention approaches, and (3) hardware for implementing these algorithms and interventions. Seizure prediction and therapies maximize efficacy, whereas minimizing side effects through improved specificity may represent the future of epilepsy treatments.