RESEARCH ARTICLE

WILEY

A novel two-band equilateral wavelet filter bank method for an automated detection of seizure from EEG signals

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Abstract

One can determinate the occurrence of epileptic seizure from the electroencephalogram (EEG) signal. Nonautomatic epilepsy detection is onerous and may be prone to error. They have augmented automated detection of seizure methods to attain accurate results. In view of this research work, we designed a frequency localized optimal filter bank to assess their effectiveness for automatic detection of seizures from EEG records. The basic preferred requirement of optimal filters relies on low bandwidth in the discipline of biomedical signal processing. This work provides a novel filter bank method called optimal equilateral wavelet filter bank (OEWFB) to satisfy the regularity criteria. This regularity constraint is being satisfied with semi-definite programming (SDP) framework, which specifically does nothing with any parameterization. Implementing the proposed filter banks, it disbands EEG signals into five wavelet sub-bands. The fuzzy entropy (FuEn), Renyi's entropy (ReEn), and the Kraskov entropy (KrEn) are being used for extracting the features from the wavelet sub-bands. The P values provide the distinctive ability of the features. Classification with 10-fold cross-validation for several classifiers such as quadratic discriminant, linear quadratic discriminant, K-nearest neighbor, support vector machine, logistic regression, and complex tree is utilized to classify the EEG signals into seizure vs non-seizure class and seizure-free vs seizure affected class. The proposed research work has gained the highest accuracy, specificity, sensitivity, and positive predictive values of 99.4%, 99%, 99.66%, and 99.35%, respectively, for class-1 (ABCD vs E). The performances of the proposed work using the Bonn EEG data set ensure validation concerning compatibility and robustness.

KEYWORDS

classification, electroencephalogram, epilepsy, optimal equilateral wavelet filter banks, seizure

1 | INTRODUCTION

Epilepsy is a known brain unhealthily condition which might trouble people of all age groups.[1] This disorder occurs because of anomalous variations of electrical discharges from the cortex brain region, which may explicitly as fits or seizures.[2] Seizures bring about a decrement in mental health, breath, fugue, and other brain health issues. Across the world population, it infests 60 million people with this seizure disorder and hugest affected population are in poor and underdeveloped countries. The functional MRI and Electroencephalogram (EEG) could make the