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A new feature for the classification of non-stationary signals based on the direction of signal energy in the time–frequency domain

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Abstract

The detection of seizure activity in electroencephalogram (EEG) segments is very important for the classification and localization of epileptic seizures. The evolution of a seizure in an EEG usually appears as a train of non-uniformly spaced spikes and/or as piecewise linear frequency modulated signals. If a seizure is present, then the energy of the EEG is concentrated along the time axis and the frequency axis in the time–frequency plane. However, in the absence of a seizure, the energy of the EEG signal is uniformly distributed along all directions in the time–frequency plane. Based on this observation, we propose a new approach for the detection of a seizure. In this paper, we develop a new feature that exploits the direction of the energy of the signal in the time–frequency domain to distinguish between seizures and non-seizures in an EEG. Our experimental results indicate the superiority of the proposed approach over other conventional time–frequency approaches; for example, the proposed feature set achieves a classification accuracy of 98.25% by only using five features.

Keywords: EEG, adaptive time-frequency analysis, seizure detection, epilepsy

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