Automatic identification of epileptic seizures from EEG signals using sparse representation-based classification

ABSTRACT

Identifying seizure activities in non-stationary electroencephalography (EEG) is a challenging task since it is time-consuming, burdensome, and dependent on expensive human resources and subject to error and bias. A computerized seizure identification scheme can eradicate the above problems, assist clinicians, and benefit epilepsy research. So far, several attempts were made to develop automatic systems to help neurophysiologists accurately identify epileptic seizures. In this research, a fully automated system is presented to automatically detect the various states of the epileptic seizure. This study is based on sparse representation-based classification (SRC) theory and the proposed dictionary learning using electroencephalogram (EEG) signals. Furthermore, this work does not require additional preprocessing and extraction of features, which is common in the existing methods. This study reached the sensitivity, specificity, and accuracy of 100% in 8 out of 9 scenarios. It is also robust to the measurement noise of level as much as 0 dB. Compared to state-of-the-art algorithms and other common methods, our method outperformed them in terms of sensitivity, specificity, and accuracy. Moreover, it includes the most comprehensive scenarios for epileptic seizure detection, including different combinations of 2 to 5 class scenarios. The proposed automatic identification of epileptic seizures method can reduce the burden on medical professionals in analyzing large data through visual inspection as well as in deprived societies suffering from a shortage of functional magnetic resonance imaging (fMRI) equipment and specialized physician.