Sleep arousal events detection using PNN-GBMO classifier based on EEG and ECG signals: A hybrid-learning model

ABSTRACT

Foremost sleep event is the sudden change of sleep stages, mainly from deep sleep to light sleep. The notion is very effective in the detection of sleep disorders. In this paper, the detection of arousal events is performed using an automatic analysis of EEG and ECG signals. Unlike previous methods, which rely solely on the detection of sleep stages, early recognition of change in sleep stages can facilitate the progression of some diseases. Detecting the change in sleep stages is a complex process and requires the expertise of a neurologist. Features can be extracted by three fractal descriptors, Lyapunov exponent and cumulatively discrete wavelet transform. A subset of the features is then applied into the probabilistic neural network optimized by Gases Brownian Motion Optimization (GBMO) algorithm. The set of EEG and ECG signals are samples of the SHHS sleep database that have been incorporated into the learning model with some pre-processing. In addition, solving uncertainty problem of responses, repeatability, and convergence to the minimum error are among the strengths of the proposed model. Compared to the conventional feature extraction and classification methods, outputs were obtained that are more acceptable, and the model for two- and four-class states reached averaged errors of less than 2% and 7% with K-fold cross-validation.