



Editorial commentary on special issue of Advances in EEG Signal Processing and Machine Learning for Epileptic Seizure Detection and Prediction

Larbi Boubchir[✉]

Laboratoire d'Informatique Avancée de Saint-Denis Research Lab., University of Paris 8, Saint-Denis, Cedex 93526, France.

Abstract

This special issue of *The Journal of Biomedical Research* features novel studies on epileptic seizure detection and prediction based on advanced EEG signal processing and machine learning algorithms. The articles selected present important findings including new experimental results and theoretical studies.

Keywords: epileptic seizure, electroencephalography (EEG), EEG signal processing, machine learning, feature extraction

Epilepsy is the most common neurological disorder of the brain that affects people worldwide from newborn to adult. It is characterized by recurrent seizures, which are brief episodes of signs or symptoms due to abnormal excessive or synchronous neuronal activity in the brain. The electroencephalogram (EEG) is a physiological method to measure and record the electrical activities generated by the brain from electrodes placed on the surface of the scalp. EEG has become the most used signal for detecting and predicting epileptic seizures. Machine learning for EEG signal processing constitute an important area of artificial intelligence dealing with the setting up of automated computer-aided systems allowing to help the medical staff, e.g. neuro-physiologists, for detecting and predicting epileptic seizure activities from EEG signals. It offers solutions

to difficult biomedical engineering problems related to detecting and predicting EEG epileptic seizures.

The main goal of this special issue is to solicit original contributions with focus on recent advances in EEG signal processing and machine learning for seizures detection and prediction. This special issue selected 9 excellent papers from 20 papers received from a general call. The following paragraphs summarize the published papers.

Ben Slimen *et al* reported "EEG epileptic seizure detection and classification based on dual-tree complex wavelet transform and machine learning algorithms"^[1]. In this paper, the authors propose a robust automatic method for EEG epileptic seizure detection and classification based on Dual-tree complex wavelet transform for feature extraction with supervised learning algorithms.

[✉]Corresponding author: Larbi Boubchir, Laboratoire d'Informatique Avancée de Saint-Denis Research Lab., University of Paris 8, 2 rue de la Liberté, Saint-Denis, Cedex 93526, France. Tel: +33-149406795, Email: larbi.boubchir@ai.univ-paris8.fr.

Received 27 May 2020, Accepted 28 May 2020, Epub 28 May 2020

CLC number: R742.1, Document code: B

© 2020 by the Journal of Biomedical Research.

The authors reported no conflict of interests.

This is an open access article under the Creative Commons Attribution (CC BY 4.0) license, which permits others to distribute, remix, adapt and build upon this work, for commercial use, provided the original work is properly cited.

Ben Slimen *et al* reported "Epileptic seizure prediction based on EEG spikes detection of ictal-preictal states"^[2]. In this study, an epileptic seizure prediction method is proposed based on the EEG spike rate in used as an indicator to anticipate seizure activities in EEG signal.

Dash *et al* reported "Hidden Markov model based epileptic seizure detection using tunable Q wavelet transform"^[3]. This paper presents a method for seizure detection based on entropy features extracted from the different sub-bands of tunable Q wavelet transform with Hidden Markov model.

Moctezuma *et al* reported "Classification of low-density EEG for epileptic seizures by energy and fractal features based on EMD"^[4]. In this paper, a novel method for classifying EEG epileptic seizures based on features extracted from Empirical mode decomposition (EMD).

Torse *et al* reported "An optimized design of seizure detection system using joint feature extraction of multichannel EEG signals"^[5]. This paper presents a real time seizure detection system for EEG epileptic seizure detection based on entropy features extracted from Ensemble EMD and TQWT decompositions of EEG signal with supervised learning techniques.

Quintero-Rincón *et al* reported "A quadratic linear-parabolic model-based EEG classification to detect epileptic seizures"^[6]. This paper develops an EEG classification method based on a quadratic linear-parabolic model and Random forest algorithm to discriminate seizure and non-seizure events.

Raghu *et al* reported "Complexity analysis and dynamic characteristics of EEG using MODWT based entropies for identification of seizure onset"^[7]. In this paper, the complexity analysis and dynamic characteristics of EEG signal based on maximal overlap discrete wavelet transform have been exploited for the identification of seizure onset.

Vanabelle *et al* reported "Epileptic seizure detection using EEG signals and extreme gradient boosting"^[8]. In this paper, the problem of automated seizure detection on the Temple University Hospital EEG Seizure Corpus dataset is treated using clinical EEG and machine learning algorithms.

Ilakiyaselvan *et al* reported "Deep learning approach to detect seizure using reconstructed phase space images"^[9]. In this study, the authors propose to use reconstructed phase space images to model the EEG signal as a chaotic system, and use them as input to Convolution Neural Network model.

In conclusion, I trust that readers will find this selection of papers interesting. In addition, I would like to thank all authors contributing to this special issue, and the reviewers for their invaluable comments and recommendations on the submitted papers. Last, but not least, I wish to thank the editorial team for their significant support throughout the process.

References

- [1] Ben Slimen I, Boubchir L, Mbarki Z, et al. EEG epileptic seizure detection and classification based on dual-tree complex wavelet transform and machine learning algorithms[J]. *J Biomed Res*, 2020, 34(3): 149–159.
- [2] Ben Slimen I, Boubchir L, Seddik H. Epileptic seizure prediction based on EEG spikes detection of ictal-preictal states[J]. *J Biomed Res*, 2020, 34(3): 160–167.
- [3] Dash DP, Kolekar MH. Hidden Markov model based epileptic seizure detection using tunable Q wavelet transform[J]. *J Biomed Res*, 2020, 34(3): 168–177.
- [4] Moctezuma LA, Molinas M. Classification of low-density EEG for epileptic seizures by energy and fractal features based on EMD[J]. *J Biomed Res*, 2020, 34(3): 178–188.
- [5] Torse D, Desai V, Khanai R. An optimized design of seizure detection system using joint feature extraction of multichannel EEG signals[J]. *J Biomed Res*, 2020, 34(3): 189–202.
- [6] Quintero-Rincón A, D'Giano C, Batatia H. A quadratic linear-parabolic model-based EEG classification to detect epileptic seizures[J]. *J Biomed Res*, 2020, 34(3): 203–210.
- [7] Raghu S, Sriraam N, Temel Y, et al. Complexity analysis and dynamic characteristics of EEG using MODWT based entropies for identification of seizure onset[J]. *J Biomed Res*, 2020, 34(3): 211–225.
- [8] Vanabelle P, De Handschutter P, El Tahry R, et al. Epileptic seizure detection using EEG signals and extreme gradient boosting[J]. *J Biomed Res*, 2020, 34(3): 226–237.
- [9] Ilakiyaselvan N, Khan AN, Shahina A. Deep learning approach to detect seizure using reconstructed phase space images[J]. *J Biomed Res*, 2020, 34(3): 238–248.