Received: 16 July 2020 | Revised: 5 February 2021 | Accepted: 11 February 2021

DOI: 10.1002/ima.22565

WILEY

RESEARCH ARTICLE

Implementation of deep neural networks for classifying electroencephalogram signal using fractional S-transform for epileptic seizure detection

S. R. Ashokkumar[1] | S. Anupallavi[2] | M. Premkumar[3] | V. Jeevanantham[3]

[1]Department of Electronics and Communication Engineering, Sri Eshwar College of Engineering, Coimbatore, Tamil Nadu, India

[2]Department of Electronics and Communication Engineering, VSB College of Engineering Technical Campus, Coimbatore, Tamil Nadu, India

[3]Department of Electronics and Communications Engineering, SSM Institute of Engineering and Technology, Dindigul, Coimbatore, Tamil Nadu, India

Correspondence
S. R. Ashokkumar, Department of Electronics and Communication Engineering, Sri Eshwar College of Engineering, Coimbatore, Tamil Nadu, India.
Email: srashokkumar1987@gmail.com

Abstract

Epilepsy is one of the most common neurological diseases of the human brain. It affects the nervous system of brain which shows the impact on an individual's life because of its repetitious occurrences of seizure. Epileptic detection using automatic learning is essential to reduce the substantial work on reviewing continuous electroencephalogram (EEG) signal in spatial and temporal dimensions. A novel methodology is implemented on EEG signals for the detection of epileptic seizure with the combination of fractional S-transform (FST) and entropies along with deep convolutional neural networks (CNN). The original EEG signals are preprocessed with discrete wavelet transform to generate Daubechies-4 (Db4) wavelets. FST is enacted on every segment of the preprocessed signal for time-frequency representation and the features are obtained through entropies. Afterwards, a 15-layer deep CNN with dropout layer and soft-max is used for classification. The experimental results showed that the singular value decomposition entropy are more stable and deep CNN models always performed better for this entropy. A specificity of 98.70%, sensitivity of 97.71%, and accuracy of 99.70% are achieved for the multichannel segment.

KEYWORDS

deep neural networks, electroencephalogram, entropy, epilepsy, fractional S-transform

1 | INTRODUCTION

Epilepsy is a common cerebral brain disorder affecting people at all ages. Abnormal neural exertion in the brain prompts recurrent seizures to occur and affects the sensory system in the human body. The World Health Organization acknowledges that about 50 million people are falling victim to epilepsy worldwide and an additional 2.5 million people are detected with epileptic seizure (ES) every year. Electroencephalogram (EEG) usually measures seizure activity because it represents electrophysiological disorders in the brain at a given time and is widely used for diagnosis because of its low cost. Enhancement of EEG signal to analyze physical and prophylactic data helps the patients to know the progress of epileptic treatment. Clinicians usually test EEG signals for three types of activity, they are normal EEG signal activity of healthy persons with open or closed eyes, seizure free (inter-itcal) conditions which may contain short spikes and seizure (ictal) EEG conditions containing sudden spikes.

Generally speaking, EEG recordings are long (hours to days) and it contains an enormous amount of patient data collected. Such recordings are difficult to inspect

