# Preface

Epilepsy is a persistent, debilitating condition that frequently results in seizures as a result of aberrant electrical impulses sent by damaged brain cells. A seizure is brought on by an uncontrolled electrical surge within brain cells. This periodic electrical impulse pattern is disturbed by epilepsy. Instead, one or more regions of the brain experience electrical energy spikes between cells. Seizures are brought on by this electrical disturbance, which alters awareness (including loss of consciousness), feelings, emotions, and muscular movements. The requirement for an automated epilepsy management system makes it crucial that such a system be responsive whenever an episode is likely to occur and can be customized to some extent to match most individuals worldwide. This study aims to enhance Epileptic Seizure (ES) detection and prediction by fine-tuning the classifier's parameters and informing the patient before impending seizures. Additionally, this research aims to provide methods for eradicating artifacts found in the collected Electroencephalogram (EEG) signal and to produce a complex feature space that represents the qualities and varied nature of EEG signals.

Artifacts are a common problem in EEG signal recordings. They can be caused by various reasons, such as eye blinks or muscle twitches. These artifacts pose a problem when diagnosing neurological disorders using automated systems. In this research work, a novel architecture is proposed to remove such artifacts from the EEG signals of epileptic patients. The proposed architecture merges a bidirectional long short-term memory network (BLSTM) and a bidirectional stochastic configuration network (BSCN). This proposed framework allows learning intricate patterns in the EEG signal's past and future time steps. Additionally, the non-iterative training of the classifier is an advantage of learning based on BSCN, which increases training effectiveness. The experiments have been performed on four epilepsy data sets and a sleep data set. The performance of the proposed technique is gauged using various performance metrics, and their values demonstrate that the proposed novel technique improves performance over the existing artifact removal (AR) techniques.

Epilepsy is a severe threat to society due to the treatment time, cost, and unpredictable nature of the disease, imposing an urgent need for intelligent analysis. EEG is a commonly deployed test for detecting epilepsy that analyzes the electrical activity of an individual's brain. This work proposes an optimized deep sequential model to improve the seizure classification performance based on a hybrid feature set derived from EEG signals. A novel hybridized Battle Royale Search and Rescue optimization (BRRO) algorithm is proposed for optimizing a deep learning (DL) model. Also, the proposed hybrid feature set utilizes empirical mode decomposition (EMD), variational mode decomposition (VMD), and empirical wavelet transform (EWT) to capture the temporal property of the data set. The proposed method is validated using publicly available data sets. The results manifest that the proposed optimized algorithm provides better results than the other alternatives.

Seizure prediction from EEG time series data and a sequential DL predictor substantially boosts epileptic patients' quality of life. However, a significant challenge is a variation in seizure characteristics with time and individuals, along with a need for more data. Also, considerable dissimilarity is noticed in the duration between various seizure stages. Thus, a patient-generic approach is required to mitigate the problem. As a result, multiple feature augmentation procedures are used to create a hybrid feature space to capture the non-linearity of epileptic seizures.

This elaborate feature space helps the predictor learn better to enhance the seizure occurrence prediction. Additionally, the predictor is optimized using a novel hybrid Forensic-based-Search-and-Rescue Optimization (FB-SARO) to improve the seizure prediction. In addition, an optimal seizure prediction horizon (SPH) is also determined through the classifier's learning. The SPH helps attain early prediction while preserving accuracy and achieving a minimum False Prediction Rate (FPR). It also helps raise the alarm to provide the patients with ample preparation time for medical assistance. The proposed approach is testified through publicly available data sets and compared with existing state-of-the-art techniques.