

A Multimodal Approach for Seizure Prediction via Brain Regional Connectivity Changes in Drug-Resistant Epilepsy

Epilepsy is a widely prevalent neurological disorder, affecting a significant portion of the global population. Regrettably, about one-third of individuals with epilepsy do not respond to treatment and are forced to live with epileptic seizures, causing social, psychological, and physical distress. For such patients, seizure prediction devices offer a glimmer of hope for an improved quality of life. However, for such devices to be effective, they require a predictive method that demonstrates exceptionally high accuracy and precision in order to be used in the clinical setting. Such methods must be generalizable and customizable to suit the unique characteristics of each patient. Moreover, they should be easy to set up for healthcare providers to use.

This study proposes that the onset of seizures can be detected by observing changes in connectivity between the epileptogenic or pathological network and other healthy networks in the patient's brain. Leveraging a database of more than 100 patients with long-recordings of intracranial stereotactic EEG and ECG, the study hypothesizes that a multi-modal system, which accounts for other variables beyond the brain signal, will improve predictive accuracy. Here we present preliminary results of a single patient. These demonstrate a remarkable accuracy and precision of more than 99% in predicting seizures in an offline fashion. The next crucial steps involve extending the framework to the whole cohort of patients and assessing the model's performance in online settings, when the patients are in room for presurgical workout. Specifically, the model's performance will be assessed in relation to other critical variables such as prediction horizon, false warning rates, and other potential confounding factors. The outcomes of this investigation could provide critical insights into the efficacy of the proposed multi-modal system, which could significantly contribute to the development of more effective and precise seizure prediction devices for patients with epilepsy.