

Labelling iEEG temporal patterns to strengthen AI-based seizure onset zone detection in patients with drug-resistant epilepsy

Identifying the Seizure Onset Zone (SOZ) from intracranial EEG (iEEG) recordings is a critical step in the treatment of drug-resistant epilepsy. This is a burgeoning area of research because approximately one-third of epilepsy patients do not respond to pharmacological therapies and may benefit from surgical intervention, which depends on accurate seizure localization. In this work, we propose a framework combining machine learning (ML) and deep learning (DL) techniques. The approach uncovers latent patterns and captures both local and long-range temporal dependencies for the classification of peri-ictal iEEG channels as belonging to the seizure-onset zone (SOZ) or non-SOZ. However, the task is complex due to several limitations, including high class imbalance, heterogeneous recordings and annotations across clinicians, and limited data availability for generalization testing. Straightforward application of DL models on these datasets results in suboptimal performance due to the mentioned challenges, highlighting the need to extract informative features and adapt neural network architectures to the data characteristics. Preliminary results on a dataset of 20 patients from an epilepsy unit, indicate that unsupervised clustering of temporal samples improves the representation of seizure-related activity, strengthening clinical annotations. Additionally, experiments with feature-based signal representations improve the performance of the models. Performance is evaluated using binary classification metrics, assessing the model's ability to distinguish between SOZ and non-SOZ channels. The proposed approach demonstrates promising generalizable performance on the dataset used in this study, although further validation on additional datasets is required.