Graph Neural Networks with Data Augmentation for Single-Channel EEG- Based Seizure Classification

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Abstract

Manual seizure identification in EEG recordings is labor-intensive, time-consuming, and prone to errors, motivating the development of automated detection systems. We propose a scalable graph-based deep learning framework using Graph Convolutional Networks (GCNs) for seizure detection. The EEG dataset was augmented to 500 samples per class (across 5 classes), and each signal was divided into 8 segments with temporal and frequency features extracted. Graphs were constructed per subject, where nodes represent segments and edges reflect feature similarity. A GCN was trained on these graphs, and features were classified using an SVM. Evaluated with 10-fold cross-validation, the model achieved 99.25% accuracy, 100% sensitivity, and 98.50% specificity, outperforming several state-of-the-art methods. This approach effectively captures spatial-temporal dynamics in EEG data, improving generalization and offering a robust alternative to traditional techniques.

Index Terms

EEG, Seizure Detection, Automated Diagnosis, Graph Learning, Deep Learning, CNN, GCN