Simplicial Network Analysis on EEG Signals

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Abstract

Epileptic time series identification, crucial for automating seizure prediction and detection, aims at alleviating the time-consuming and laborious process of visual inspection by experts. Recently, network analysis has become a leading method for classifying electroencephalogram (EEG) time series, entailing the conversion of EEG data into diverse networks, like visibility graphs, for subsequent analysis of their topological properties. It utilizes simplicial approach, where the EEG visibility graphs are employed as simplex networks to extract maximal cliques and further derive five characterizers to delineate the structural anatomy and connectivity of the network, with enhanced details of both global and localized dynamical behavior. The analysis spanned three databases: University of Bonn and Temple University Hospital databases for detection, and New Delhi EEG Database for detection and prediction. Classification accuracy, evaluated using SVM and feed-forward neural networks, consistently favored the proposed characterizers over regular network parameters across all three databases, indicating their superior effectiveness in seizure detection and prediction.