

Investigation of Epileptic Seizures by Analyzing EEG Data using Machine Learning

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Purposes:

- Identifying epileptic seizures focus
- Investigating the possibility of seizure prediction

In this work, first we introduce some concepts and tools to analyze electroencephalography (EEG) data and then we try to investigate two sets of EEG data using these methods. First, we compute correlation matrix using moving statistics for increments of data set 1 as well as focal and non-focal areas separately and then we find probability density function of eigenvalues of this matrix. At last, by investigating this function for the second eigenvalue, we find that for each patient in the data set the second peak in ictal states for focal areas is higher than the one for non-focal areas. In the second part of this work, we investigate correlation states between different areas for second data set by employing a tool widely used in the field of Machine Learning namely hierarchical clustering. In this method after the computation of moving correlation matrix by using Average-Linkage clustering, we try to find correlation states and then time evolution of state of the system. By investigating plots corresponding to time evolution of states, we conclude that system state in time period of epileptic seizure is different from stable state before the seizure. In addition, correlation states for post-ictal data are very different from correlation states for other periods of time. On the other hand, by observing the change of system state in approximately 17 minutes before seizure onset, we conclude that this shows the possibility of prediction of the seizure. At last, by investigating correlation states in each time period, we can observe that focal areas are strongly correlated in all of states and this situation does not depend on the time period that we studied.

Keywords:

Epilepsy, Epileptic Seizure, focal and extra-focal areas, Pearson Correlation Matrix, Hierarchical Clustering, Average-Linkage Clustering Algorithm, Correlation States, Ictal State