Connectivity analysis of EEG recordings for Epileptic patients

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Abstract

We propose a novel approach of *connectivity analysis* for EEG recordings of epileptic patients. The final goal of this study is to integrate EEG and fMRI to extract temporal and spatial information about seizure focus. However, in this paper we only report the EEG connectivity analysis. EEG measurement with milliseconds temporal resolution has formidable information for understanding the temporal dynamics of the brain during interictal epileptic activations. Since these interictal epileptic activations are non-spontaneous and low-probability events, investigating the brain connectivity during these activations is rather challenging.

Discrete wavelet transform is applied on preprocessed EEG recordings acquired in MR scanner from epileptic patients to study the correlations between different regions of the brain in a specific frequency band during interictal epileptiform discharge (IED) and non-IED time intervals. These IED and non-IED labels are manually marked on EEG signals by an expert neurologist. The correlation of concatenated wavelet transform of IED and non-IED time intervals is estimated. Two graphs indicating the brain functional network during IED and non-IED segments have been obtained after thresholding the IED and non-IED wavelet correlation matrices. These graphs are different for various epileptic patients. The distinct connections between these IED and non-IED graphs can provide some valuable information about the seizure focus and their inter-connections.

To relate temporal dynamics of spatial seizure focus in future works, first we will study the connectivity analysis for the estimated spatial characterisations of EEG recordings based on inverse problem methods; second a combination of independent component analysis (ICA) and connectivity appproches will be considered on fMR images. Finally we will investigate how to characterize the neural seizure activities by comparing the connectivity resullts.