ABSTRACT

The brain cells communicate through electrical impulses and these “impulses” so called electrical activity are active all the time, even when the person is asleep. These electrical activity can be measured using Electroencephalogram (EEG) in the form of signals on human scalp. The recording of those electrical activity are produced by the firing of neurons within the brain. The importance of neuro-biological time series analysis, which exhibits typically complex dynamics, has long been recognized in the area of nonlinear analysis and the hidden dynamical activities of the brain can be detected and analyzed using some of the non-linear invariants. The analysis of EEG signals have well potential to detect different cognitive behavior of healthy persons or patients when they engaged with varying mental tasks. The current research aim is to analyze the differential activity of the brain during various cognitive task and understanding the dynamical processes in the brain, that are the basis of physical and mental behaviors. This Thesis proposes a methodology for EEG non-linear invariants and source connectivity analysis that partially overcomes the significant limitations of the traditional approach. Hence, the unpredictable nature of the EEG might be considered as a phenomenon for exhibiting its chaotic nature. The essential property of chaotic dynamics is emphasized using the nonlinear methods. Through the nonlinear features, the classification approaches used to classify various cognitive brain states. Followed by to analyze the brain electrical activity source localization, we analyze three dimensional (3-D) reconstruction using standardized low resolution brain electromagnetic tomography (sLORETA). Subsequently to understand there connectivity
patterns of electrical activity of various brain region, the graph theory connectivity analysis was taken in consideration.

The connectivity analysis has been applied for the analysis of EEG activity for both healthy subjects and patients. The statistical features used to measure the significant or insignificant levels. The features of the EEG pattern also helps in estimating the deviation of the patient data with reference to the normal data for a specific task. This cumulative approach make an enlightening towards automating the process of analysis of brain activity patterns, which is the need of the day. This is not only helps the neurologist/neurosurgeon in understanding the minute details of the features of the activity pattern but also help in rapid diagnosis. The speeding up of the diagnosis and surgical outcome. The clinical diagnosis process traditionally followed by the expert neurologists/neurosurgeon, which may be initially addressed by the introduction of computer based algorithms. This process helps them cater to larger patient population in a specified time. This technique may also help to the general medicine doctor to make an initial evaluation in the hospital where trained expert neurologists/neurosurgeon doctors are not there and followed by they can sent the patients to the subsequent specialized doctor/hospital.