"Keep on the lookout for novel ideas that others have used successfully. Your idea has to be original only in its adaptation to the problem you’re working on."

- Thomas Edison

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Epilepsy is a chronic neurological disorder characterized by recurrent seizures as a result of brief hyper-synchronous paroxysmal discharges of neurons. At present, about seventy million people worldwide are affected by epilepsy. It includes people of all ages ranging from neonates to elderly having varied aetiologies and manifestations with distinct types of seizures. The diagnosis of epilepsy is most commonly performed by using electroencephalography and involve visual scrutinization of electroencephalogram (EEG) signals for the detection of epileptiform patterns by a trained neuro-clinician. But, the process of manual detection is very time-consuming and inefficient, especially in the case of long-term EEG recordings. Moreover, the inspection process is affected by overlapping symptomatology of epilepsy with other neurological disorders and contamination of EEG signals (especially the extracranial or scalp recordings) with artifacts. This makes the visual scrutinization procedure very challenging even for an experienced neurophysiologist. The problem is even more cumbersome when it comes to finding the source of epileptic seizures through EEG. The repercussions of delayed diagnosis or mis-diagnosis could lead to permanent neurobiological, cognitive, social and psychological impairments. For these reasons, automated detection and localization of epileptiform patterns would serve as a
fundamental clinical tool for scrutiny of EEG data in a much more robust, accurate and efficient manner.

Rigorous researches have been performed to address these issues. However, the available solutions suffer from one or more gaps in knowledge that makes them inefficient for use in clinical settings and therefore, unpopular among neurophysiologists. These gaps in knowledge include: 1) compromise in statistical performance; 2) questionable robustness against less than 50 % of training data; 3) lack of testing on newly acquired data from clinics; 4) focus limited to classification of segments; and 5) expensive software that relies on user’s knowledge about epileptiform patterns. This thesis contributed in overcoming these gaps in knowledge through the development of an intelligent system, which also unveiled key research findings.

Based on the research work conducted in this thesis, statistical and non-statistical features were extracted and machine learning models were proposed for intelligent seizure detection. The models developed in this work demonstrate accurate (> 98 %) and coherent statistical performances. Finally, the model was translated to develop an indigenous tool named ‘Nataraj’ for analyzing continuous EEG recordings in clinics. This tool assists in fast and accurate, pre- and post-diagnosis of epilepsy in patients already undergoing/ have the potential of undergoing pharmacological and/ or surgical treatment. The overall development can be of utmost use in developing and under-developed countries where the patients to neurologists’ ratio are high. In future, Nataraj tool could also be integrated with an EEG instrument and deployed as a complete telemetry device for remote diagnosis by primary healthcare/ front line worker.