Summary

Diagnostic tools, currently used in the clinical setting to aid in the diagnosis of various neurological diseases, are often limited by subjective interpretation and the absence of continuing neurological symptoms (e.g. seizures) required to make a diagnosis. Consequently, these limitations may reduce the sensitivity of the investigation, the specificity, or both. Electroencephalography researchers have attempted to reduce this subjectivity and the reliance on neurological symptoms by utilising computer-assisted classification algorithms that use scalp electroencephalogram (EEG) data to make a diagnostic decision that is not reliant on neurological symptoms being present. Measures of EEG characteristics are then obtained and compared. Most commonly, EEG power in specific frequency bands is calculated (spectral analysis) and diagnosis attempted. In recent years, adjacency matrices based on some form of connectivity between EEG sensors or sources are constructed which comprise a number of nodes (regions of the brain) and edges (connection strengths between these nodes). Adjacency matrices may also be used to calculate graph theory measures, such as the clustering coefficient and the shortest path length, which define how all the nodes interact with each other and are able to determine whether there are clusters of brain regions that are highly interconnected. Several recent studies have utilised the adjacency matrices and graph theory measures in classifying neurological diseases such as epilepsy and Alzheimer's disease and have shown them to be successful (Magnin et al., 2009; Zhang et al., 2012; Challis et al., 2015; Khazaee et al., 2015; Wang et al., 2015b; Hassan et al., 2015). However, there are few studies that test whether these measures are superior to less complex analytical techniques such

as spectral analysis. This distinction is important as diagnosing a disease may not require complex analytical techniques even though such techniques might be essential in understanding the disease. Moreover, it is beneficial to the clinical setting to determine whether there are any cheaper alternatives to the current EEG systems, or systems that are mobile, as a number of patients may be house-bound. In the present study, I will be testing whether the simplest analytical methods for EEG are on-par with some of the more complex analytical methods that have been utilised in previous studies, and to determine whether there is a simple method that can be implemented in the clinical setting. I will then determine if the signal quality from cheaper/mobile EEG systems are on-par with the current top-of-the-line EEG systems to increase diagnostic accessibility and to reduce costs in the clinical setting.

High classification accuracy was consistently found with bipolar disorder, schizophrenia, and dementia, but not with the other diseases studied. It was also found that, in most cases, the simpler analytical techniques yielded a higher proportion of informative channels. This finding strengthens the possibility of utilising simpler methods in diagnostic studies with a large number of participants, that is achieving the goal of eventually building a diagnostic tool to be used widely in the clinical setting. It was also found that cheaper/mobile EEG systems recorded data that was on-par with highly sophisticated EEG systems, in terms of data quality. Together, these findings support the prospect of having disease classification programs using relatively simple diagnostic features utilised in mobile EEG systems that can be brought to a location more convenient for patients.