Functional Connectivity Mapping for Brain Disorder

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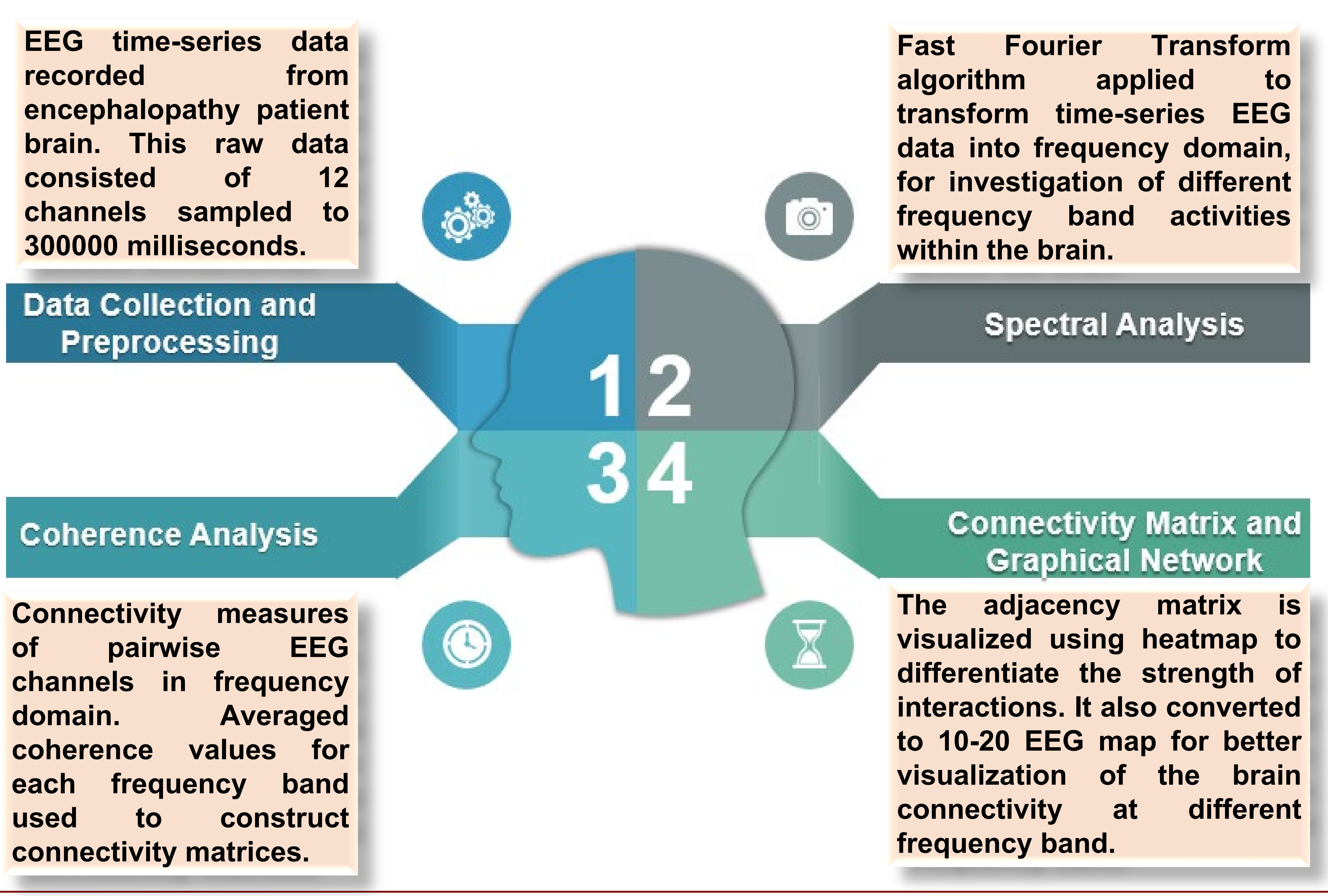
Abstract

Electroencephalogram (EEG) is a comprehensive method to record brain signals. Signal processing methods will be used to clarify and extract useful information from the brain signal in order to differentiate between normal and abnormal brain condition. This project investigate EEG dataset from encephalopathy subject in order to compare between normal and abnormal brain using spectral analysis. Connectivity analysis is then conducted to develop functional network mapping for the abnormal brain. This study shows that slow rhythm frequency band for encephalopathy subject indicate higher power spectrum compared to normal subject. Functional interactions between EEG signal will be visualized using heatmap and graphical network to facilitate brain network analysis.

Introduction

High density of EEG data increases the complexity of signal processing and analysis of brain signals. However, with the appropriate analysis method implemented, valuable and useful information recorded from the brain could help in the diagnosis of abnormal brain condition. Signals pre-processing, filtering and spectral analysis will be implemented to extract frequency content of the EEG dataset [1]. Further investigation including coherence analysis and network theory analysis to explore and visualize the functional interactions among brain regions [2]. Coherence analysis is applied to perceive the connectivity of the brain function and to measure the pairwise link in the brain at different frequency bands. Adjacency matrix constructed based on the coherence values presents the strength of connections within the brain. Functional brain connectivity can be shown using graphical network mapping to illustrate the brain activities.

Materials & Method



Results & Discussion

Comparison between normal and encephalopathy patient

	Encephalopathy	Normal [3]
Max Delta Power at 3Hz	10000	1450
Max Theta Power at 6Hz	5383	600
Max Alpha Power at 10Hz	2415	600
Max Beta Power at 20Hz	79	300
Max Gamma Power at 30Hz	62	200

Table above shows the maximum value at different frequency bands. The spectral power of brain signals in encephalopathy subject at delta, theta and alpha bands were greater than the healthy subject [3] while beta and gamma power of normal subject are greater than the encephalopathy subject.

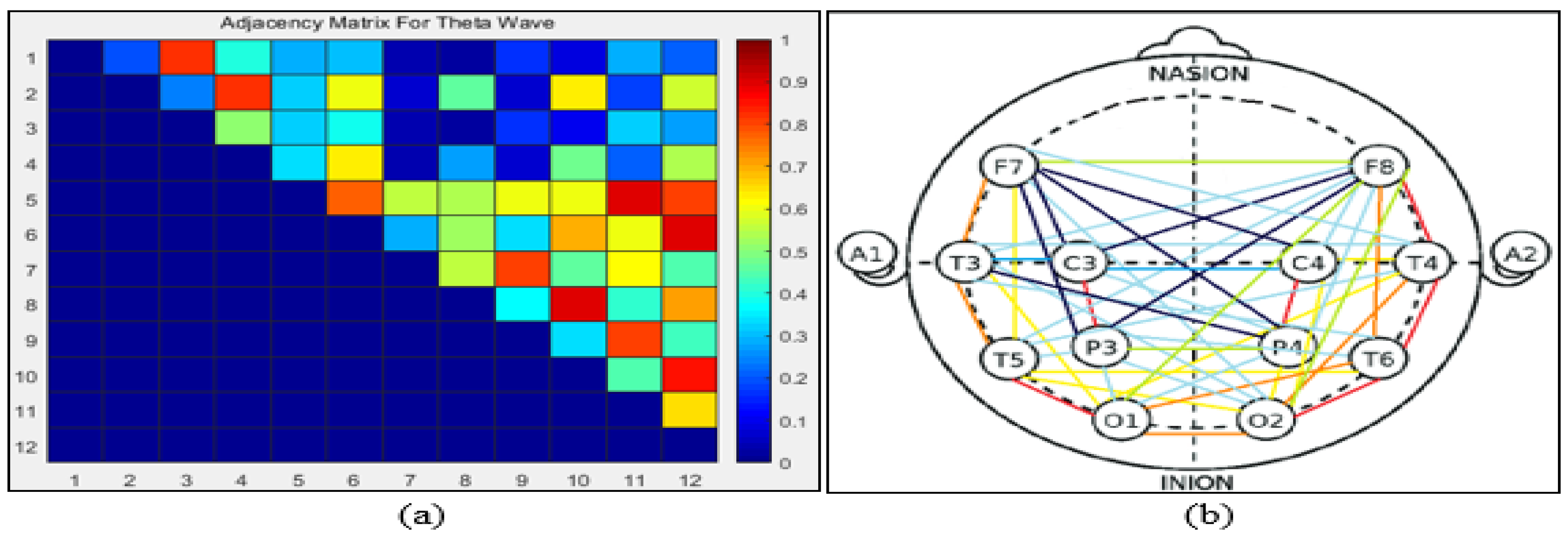


Figure above presented to show that most of the links in theta band portrayed low correlation between the channels. From the adjacency matrix in (a) and graphical network in (b), more colours ranged from 0 until 0.5 which represented low connectivity compared to colours ranged from 0.5 until 1 which represented high connectivity between the channels. Comparison with other frequency band shows that highest correlation in theta band is also the strongest connectivity compared to correlations in the other frequency bands.

Conclusion

This study shows that normal and abnormal brain function can be differentiated by using spectral analysis where the slow rhythm subband (delta, theta, alpha) for encephalopathy subject indicate higher power spectrum compared to normal subject. In addition, the correlation between EEG signal can be visualized using heatmap and graphical network to facilitate brain network analysis. For future recommendation, this analysis should be conducted on both normal and abnormal datasets with larger number of samples.

References

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3. H. Namazi and V. V. Kulish, "Mathematical modeling of human brain neuronal activity in the absence of external stimuli," in *Journal of Medical Imaging and Health Informatics*, 2012, vol. 2, no. 4, pp. 400–407.

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