(Un)Consciousness and Time-Series Complexity
A study with spontaneous EEG

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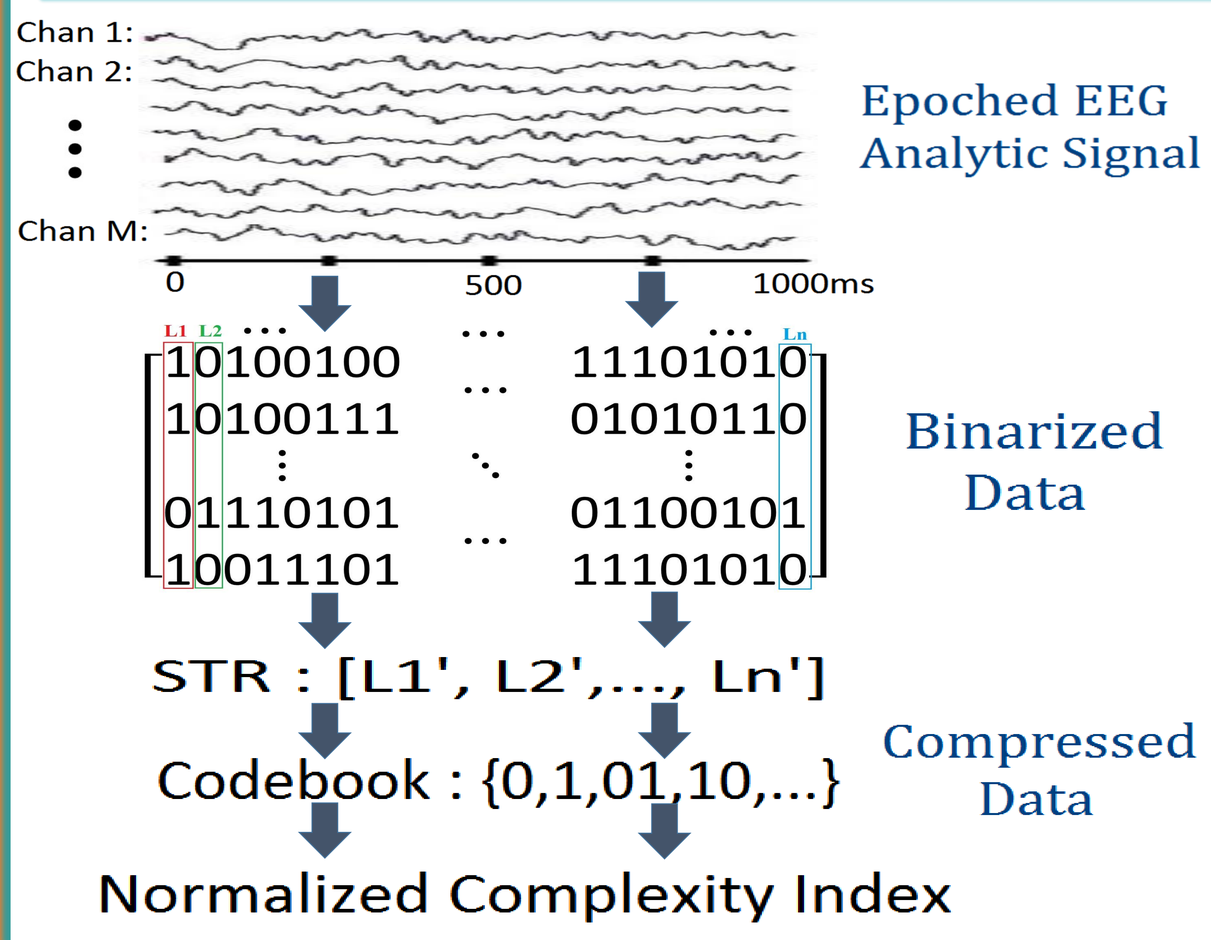
1. AIM

- To estimate the time-series complexity of spontaneous high-density EEG data during various levels of consciousness.

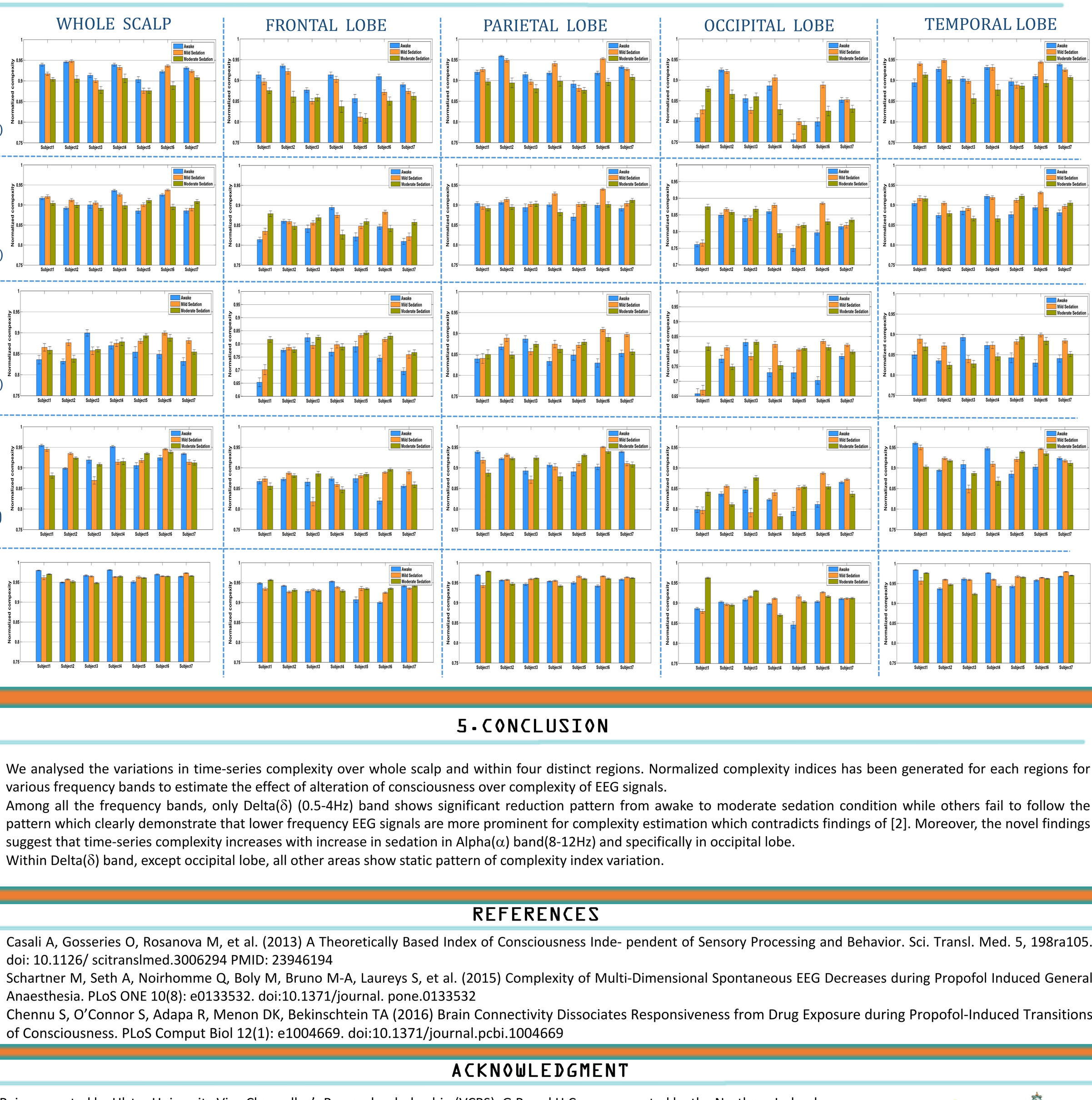
2. INTRODUCTION

- Awake or conscious human brains possess both *integration* of information (interactions among all regions) and *differentiation* of information (specific interaction within sub-regions). Emerging neural theories suggest reduction in these two phenomena as a strong biomarker for both level and content of consciousness.
- A recent study on EEG responses to transcranial magnetic stimulation by Casali et al [1] has shown high correlation between conscious level of brain and logarithmic complexity in electrophysiological signals. This theory-driven approach suggested a substantial decrease in the complexity of spatiotemporal pattern of triggered cortical activations with loss of consciousness.
- Another study by Schartner et al [2] studied the variations in the time-series complexity of spontaneous EEG and proposed an overall decrease in complexity of EEG signals in distinct brain regions and frequency bands.
- Here we investigate Lempel-Ziv complexity for three levels of consciousness (Awake, Mild Sedation and Moderate Sedation) with high-density spontaneous EEG data of seven subjects. The dataset was analysed earlier by Chennu et al [3] and is freely available online. Our objective is to find significant combinations of brain areas and frequency bands which demonstrate a static variation pattern of normalized complexity.

3. ALGORITHM



4. RESULTS



5. CONCLUSION

- We analysed the variations in time-series complexity over whole scalp and within four distinct regions. Normalized complexity indices has been generated for each regions for various frequency bands to estimate the effect of alteration of consciousness over complexity of EEG signals.
- Among all the frequency bands, only Delta(δ) (0.5-4Hz) band shows significant reduction pattern from awake to moderate sedation condition while others fail to follow the pattern which clearly demonstrate that lower frequency EEG signals are more prominent for complexity estimation which contradicts findings of [2]. Moreover, the novel findings suggest that time-series complexity increases with increase in sedation in Alpha(α) band(8-12Hz) and specifically in occipital lobe.
- Within Delta(δ) band, except occipital lobe, all other areas show static pattern of complexity index variation.

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