STUDY OF PARAMETER'S INFLUENCE IN BRAIN CONNECTIVITY ESTIMATION

Supervising staff

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Context

This project will be performed in collaboration and with the help of the Department of Neurology at the CUB Hôpital Erasme.

Epilepsy is a disorder of the brain characterized by an enduring predisposition to generate epileptic seizures and by the neurobiological, cognitive, psychological, and social consequences of this condition (Fisher et al., 2005). Epilepsy has variable etiologies, may affect both children and adults, and has an annual incidence of 4–8/1000. In about a third of epileptic patients, seizures do not respond to conventional anti-epileptic drugs.

Management of epileptic patients in the Intensive Care Unit (ICU) is challenging. The ability to anticipate an upcoming seizure would be valuable both for patient management and as a predictor of treatment adequacy.

Recently, a new technique to investigate epilepsy emerged: the investigation of brain connectivity, characterizing how highly specialized brain regions communicate with each other (Ismail and Karwowski 2020). Indeed, epilepsy is widely believed to result from a disruption of healthy brain network properties (van Mierlo et al. 2014). By modeling the brain as a connectivity graph, the interactions between its regions can be studied formally, allowing quantitative characterization and interpretation of the specific patterns observed (Farahani, Karwowski, and Lighthall 2019; van Diessen et al. 2015). Such a connectivity graph is shown in Figure 1.

Brain connectivity estimation is undertaken by graph theory. While this framework offers classical steps for constructing connectivity networks, the impact of the many parameters involved at each stage has received little attention in the literature. Yet, these parameters can significantly influence the results obtained, and are therefore crucial in the evaluation.

Work

This work aims to design and implement a method for brain connectivity analysis with graph theory based on the current framework available at our lab, and validate it on electroencephalographic signals (EEG) from patients at the Intensive Care Unit (ICU). More specifically, key parameters in evaluating brain connectivity will be reviewed, and their impact on the final connectivity results will be assessed. Recording of electroencephalographic signals (EEG) from patients at the Intensive Care Unit (ICU) will be provided.

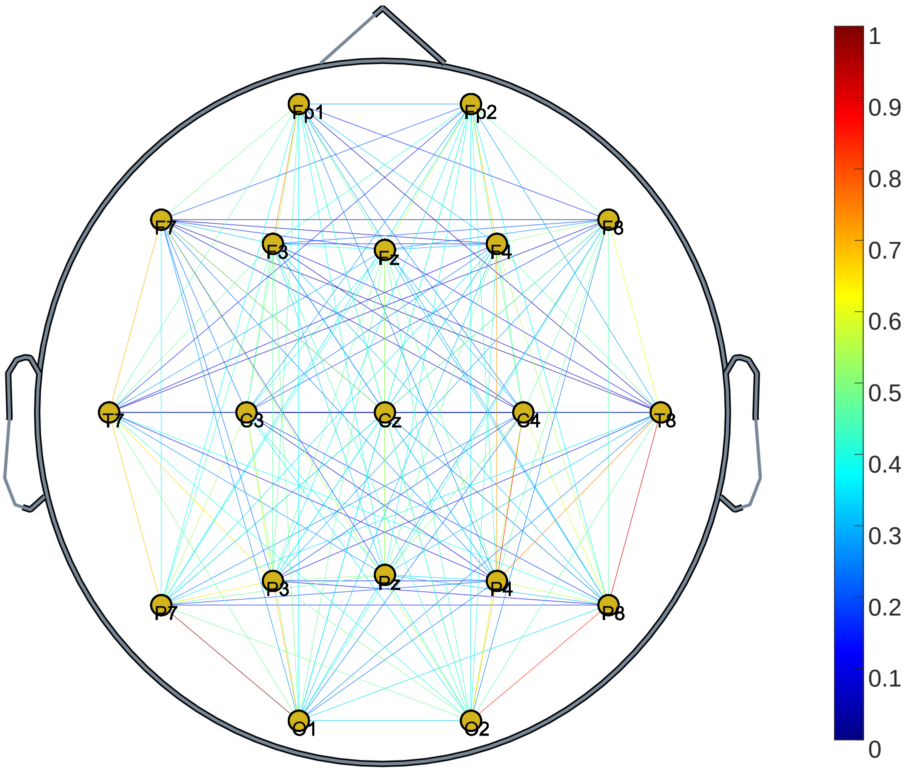

Figure 1. Representation of a brain connectivity network. This graph was computed from EEG data, its nodes are the electrodes and its associations were estimated thanks to a measure quantifying the consistency of phase differences between the time series recorded at the considered electrodes. The association strengths range from 0 (no connectivity, in blue) to 1 (high connectivity, in red). This figure was generated using (Johann 2022).

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