MODELING SCHIZOPHRENIA

with reduced Wong-Wang model

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INTRODUCTION

Schizophrenia is a complex mental health condition that significantly affects thinking, emotions, and behavior. Symptoms such as delusions, hallucinations, and disorganized thoughts can make daily life and relationships challenging, often leading to feelings of isolation for both individuals and their loved ones.

This project uses the **Reduced Wong-Wang model to simulate brain dynamics**, focusing on excitatory-inhibitory interactions to study key features like oscillations and network synchronization.

AIM

The primary aim of this project is to use the Reduced Wong-Wang model to simulate and analyze brain network dynamics relevant to schizophrenia. Specific goals include:

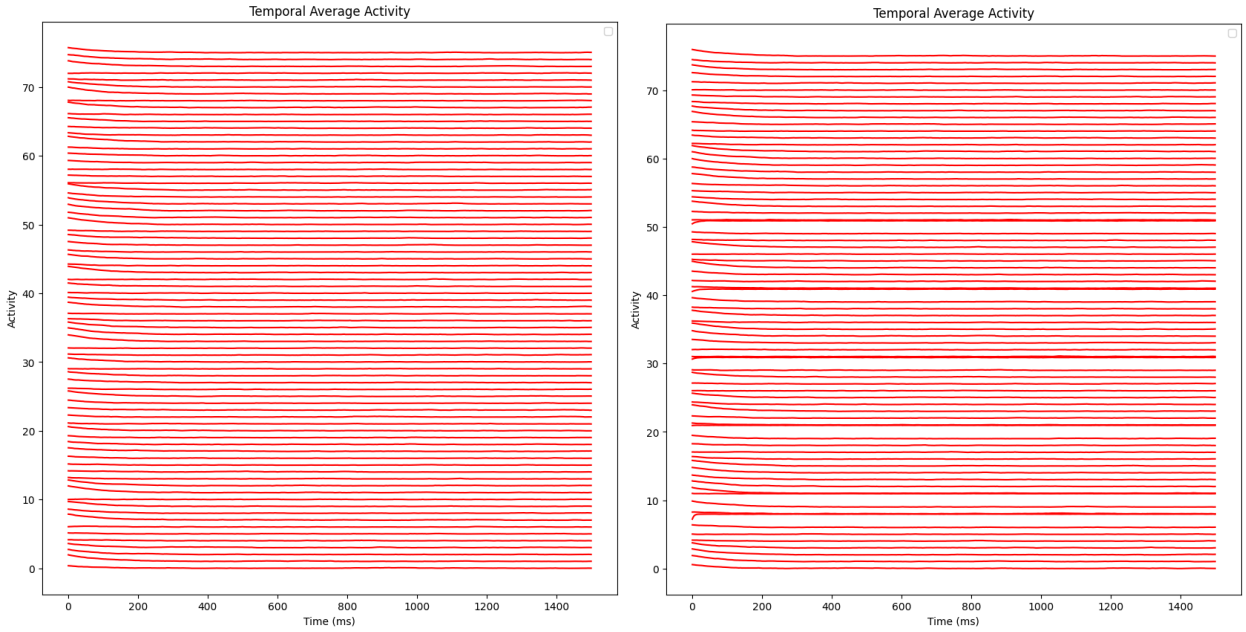
1. Exploring **how changes in neural parameters affect brain activity**.
2. Investigating the emergence of **dysconnectivity patterns** observed in schizophrenia.

RESULTS & DISCUSSION

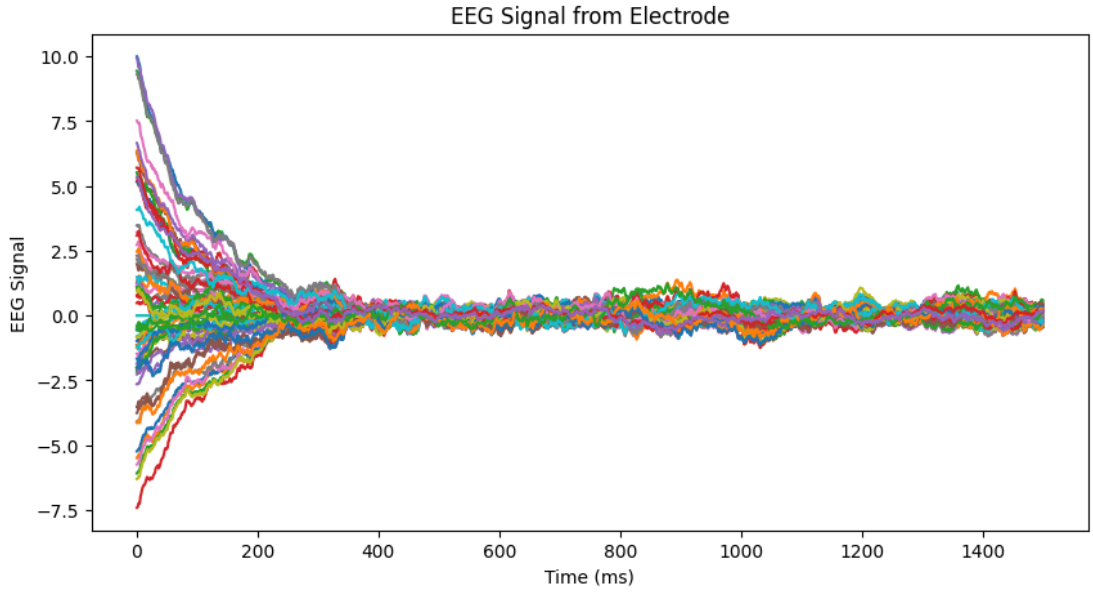
To compare between a healthy control and a schizophrenic patient we use the output from the simulation; **Temporal Average Activity and Electroencephalogram**. We plotted the TAA and EEG graphs as well as the **Functional Connectivity** (Correlation) **matrix**.

The TAA graph of the healthy control (*left image*) shows that the brain activity signals are **highly stable and consistent through time**. Only a small displacement in the beginning (when exposed to the stimulus) can be observed.

The TAA graph of the patient with schizophrenia (*right image*), while largely similar, **exhibits reduced activity in the DMN regions** (7, 10, 20, 30, 40, 50) at the beginning.



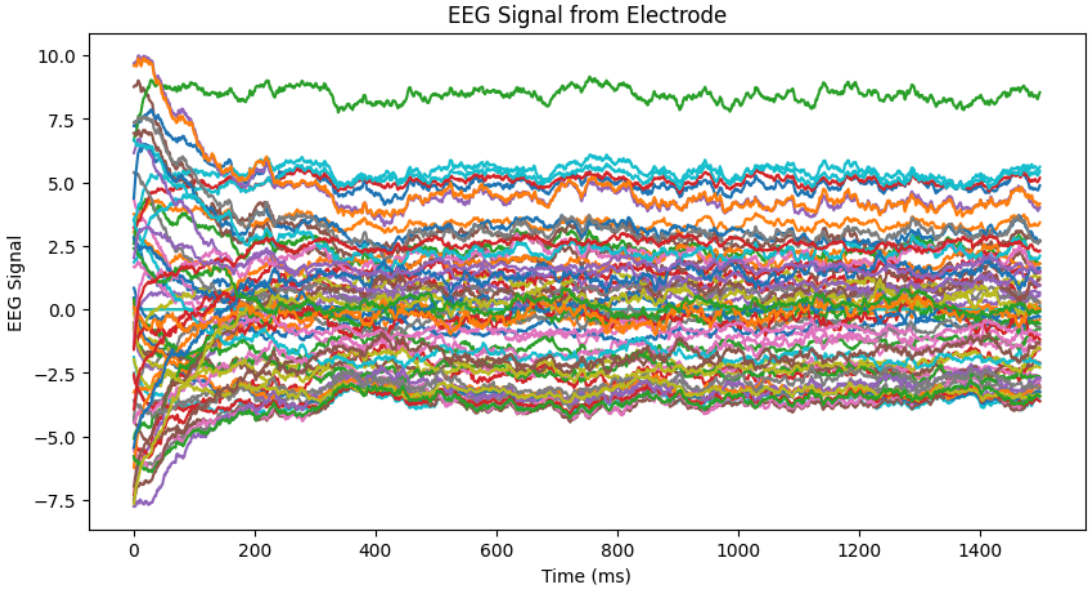
The EEG graph shows that the healthy brain, before the exposure to the stimulus, was in a resting state, its signals are more variable as the brain is not engaged. After 250ms, **we see signals converging to a tight trajectory**, indicating brain engagement in the stimulus processing.



For the patient with schizophrenia, the EEG graph shows a **lack of convergence**, signs of **desynchronization** and **difficulties in the ability of the brain to communicate within its regions**.

The observed high-frequency patterns have been associated with **altered perception** in

schizophrenia, though further investigation is needed to confirm a direct link to hallucinations.



In the correlation matrix, we can see **how different regions of the brain are affected by one another**.

For a **healthy** patient (*left image*), in the processing of the stimulus, the brain regions have **positive correlation between them**, which is expected for a synchronized brain.

For a patient with **schizophrenia** (*right image*), connectivity is **disrupted** in certain regions and **strengthened** in others in an **altered** way. Our results suggest possible **aberrant network dynamics**, particularly **impaired synchronization** in the frontal-parietal network, which aligns with previous findings in schizophrenia research.