

Abstract poster BARCCSYN 2024 – Wiep Stikvoort

Non-equilibrium brain dynamics elicited as the origin of perturbative complexity

One of the prominent theories in consciousness today is the Integrated Information Theory (IIT) which postulates that consciousness arises from the integration and segregation of information in a system. This theory gave rise to the Perturbational Complexity Index (PCI), a metric which measures the integration of a perturbation in the brain. . It has been shown to distinguish different levels of consciousness with high accuracy. Examples of different states are wakefulness versus sleep or Disorders of Consciousness (DoC)

From a thermodynamics point of view the brain can be seen as a system in nonequilibrium. By measuring the irreversibility of the dynamics, the level of nonequilibrium of a system can be determined. It has been found that higher levels of irreversibility are found in subjects residing in higher levels of consciousness.

In this work we fit whole brain models to fMRI data from subjects in a control state, a Minimally Consciousness State, and an Unresponsive Wakefulness State, as well as from people residing in wakefulness and deep sleep. We calculate the amount of irreversibility in the dynamics and simulate perturbations to calculate the PCI. We hypothesize that the underlying reason for the change in PCI in different states comes from a difference in nonequilibrium of the system caused by the asymmetry in connectivity.