

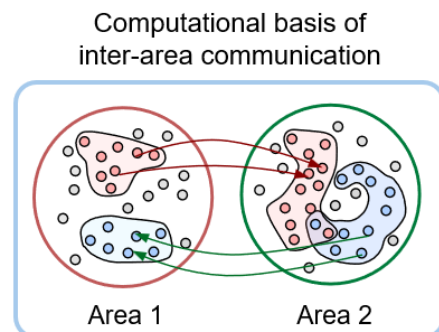
Master Project

Understanding How Brain Regions Communicate Using Computational Models

This project will explore how neuronal populations communicate with each other across cortical areas in the brain. We will build computational models of the cortical network, perform simulations and analyses to elucidate these principles, and validate the findings using experimentally recorded datasets from previous studies.

Background

The coordinated activity of neurons in the brain forms the basis of our cognition and action. With advances in large-scale recording techniques such as multi-area two-photon microscopes and neuropixel probes, we are now able to simultaneously record from multiple neuronal populations across increasing number of brain regions. These emerging recording techniques allow neuroscientists to study brain interaction at a new scale. Statistical tools such as canonical correlation analysis (CCA) and reduced rank regression (RRR) are regularly applied to analyze the interactions between two brain areas, yet we still lack understanding in the biological interpretation of these tools. What do these methods capture in interconnected neuronal networks? How should their results be interpreted, and what factors affect their reliability? This project addresses these questions through computational modeling combined with validation in experimental datasets.



Goals

The primary goals of this project are as follows:

- (1) Build computational models of two-area neuronal networks with different interaction characteristics
- (2) Apply standard analysis tools to characterize inter-area communication in these models;
- (3) Characterize how changes in model parameters affect analysis results;
- (4) Compare modeling results with those from experimentally recorded datasets.

Your profile

- Programming experience (Python/Matlab).
- Interested in neural computation.

Supervision

This project will be jointly supervised by Dr. Shuting Han, a SNSF Ambizione junior group leader, and Dr. Matthias Tsai, a postdoctoral researcher in the lab of Prof. Fritjof Helmchen at the Brain Research Institute.

Contact

Interested students should send an e-mail to han@hifo.uzh.ch and tsai@hifo.uzh.ch. Please attach a brief statement explaining your background/broad interests, and a copy of your CV.