Multimodal modeling framework for fusing structural and functional connectome data

https://neurodegenerationresearch.eu/survey/multimodal-modeling-framework-for-fusing-structural-and-functional-connectome-data/

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Country

USA

Title of project or programme

Multimodal modeling framework for fusing structural and functional connectome data

Source of funding information

NIH (NIA)

Total sum awarded (Euro)

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Start date of award

30/09/2016

Total duration of award in years

5

The project/programme is most relevant to:

Alzheimer's disease & other dementias

Keywords

connectome, Magnetoencephalography, Presenile Alzheimer Dementia, Bayesian Analysis, Graph

Research Abstract
PROJECT SUMMARY / ABSTRACT Project Summary A key goal of computational

neuroscience is to discover how the brain’s structural organization produces its functional behavior, and how impairment of the former causes dysfunction and disease. Rapid advances in neural measurement technologies are finally beginning to enable in vivo measurements of large-scale functional organization (via EEG, MEG, fMRI, PET, optical imaging) and the underlying structural connectivity architecture (via diffusion MRI, tractography). Traditional non-linear numerical simulations of single neurons or local circuits is challenging to extrapolate to macroscopic brain dynamics, and deterministic brain network models are needed that can integrate across modalities and scales. We propose an ambitious multi-scale, parsimonious and analytic model of brain function based on spectral graph theory. Bayesian inference using graphical modeling is proposed to deduce structure from function. These algorithms will be implemented and shared via a Network Dynamics Workbench that can be used by neuroscientists and clinicians to perturb structure and generate hypotheses regarding functional impairment in stimulus and disease conditions. The key insight underlying this proposal is that the emergent macroscopic behavior of the brain is essentially deterministic, and is undergirded by network “eigen-modes”. We will develop graph models of neural dynamics that are accessible analytically by simple equations rather than via numerical simulations. These models will be minimal and simple, and linear wherever appropriate. The final deliverable is a Network Dynamics Workbench for experimentally interrogating brain function and dysfunction. Relevance Neurological and psychiatric disorders constitute an overwhelming burden of disease today, especially in a rapidly aging population. A validated model of brain function predicted from structure will provide a critical tool in understanding and fighting these disorders.

Lay Summary

A key goal of computational neuroscience is to discover how the brain’s structural organization produces its functional behavior, and how structural impairment causes dysfunction. We propose an ambitious multi-scale, parsimonious and analytic graph theoretic model of brain function, and a Bayesian inference algorithm to achieve multi-modality fusion. We envisage a computational workbench that can interrogate how pathology or external stimulus perturbs the dynamics of the brain and causes dysfunction.

Further information available at:

Types:
Investments > €500k

Member States:
United States of America

Diseases:
Alzheimer's disease & other dementias

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Database Categories:
N/A

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N/A