Computational frameworks for integrating large-scale cortical dynamics, connectivity, and behavior

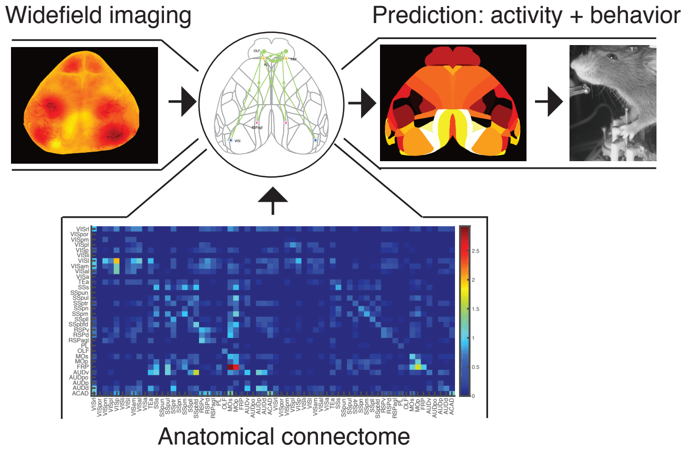
What will be delivered? We will take advantage of high-resolution datasets of cortex-wide neural activity and anatomical connectivity to develop mathematical models that integrate multiple data modalities to predict global neural dynamics and rich behavioral outputs. Our research will produce analytical tools capable to reveal distributed circuit mechanisms for behavioral and cognitive functions.

What is new inside? Aim 1: Dimensionality reduction of the global neural dynamics based on the anatomical connectivity of the mouse cortex. The low-dimensional model of mesoscale dynamics constraints multiscale models to bridge between single cells and global dynamics. Aim 2: Inference of effective low-dimensional circuits from high-dimensional neural activity recorded during behavioral tasks. Circuit inference applied to multi-area recordings to reveal distributed mechanisms of decision making.

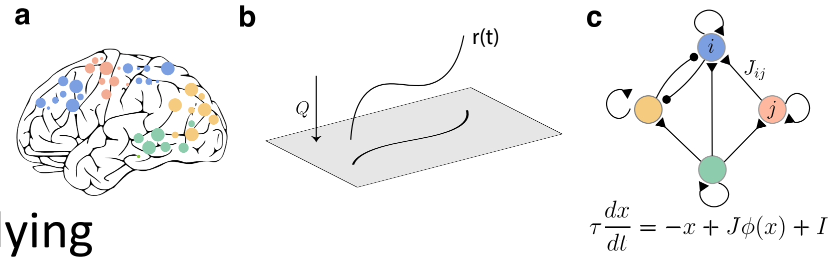
How will this change current practice? Most methods for analyzing high-dimensional neural activity data detect correlations without links to the underlying anatomical connectivity and circuit mechanisms. Mechanistic theories developed here will open possibilities for causal testing in perturbation experiments.

End Users Our computational frameworks can be used by theorists and experimentalists to derive mechanistic theories of distributed neural computations from data.

Aim 1: Integrate dynamics with connectome and behavior



Aim 2: Circuit reduction methods



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