Data-driven discovery of neural computations through brain-wide and cell-type-specific dynamical systems

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Mechanistic understanding of neural population dynamics implementing specific computations may require measuring, modeling, and controlling neural activity in behaving animals in a principled manner. Here we present a data-driven discovery framework through closed-loop integration of large-scale neurophysiology and dynamical systems modeling. This approach enabled unexpected discovery of cell-type-specific habenular line attractor dynamics implementing reward history computation [1]. Building on this finding, we created a brain-wide spiking activity map in value-based decision-making, identifying dynamical structures implementing bidirectional value update [2]. This process has been facilitated by parallel technology development efforts including structure-guided engineering of optogenetic actuators and sensors [3–5] and artificial intelligence-assisted holographic microscopes [6, 7].

References:

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