

Targeted Project / AY 2023 -2024

Data driven prediction of neural dynamics using machine learning and neural networks

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Department/Institute: Engineering

Research area: Neurophysiology, data science, neural engineering

Project outline:

Increasing climatic temperature variations challenge life on the planet in complex ways. Cold-blooded animals that lack the homeostatic temperature regulation (poikilotherms) are particularly exposed to such environmental perturbations. At the same time, poikilotherms possess robustness mechanisms that allow them to cope with acute temperature changes. We have scant understanding of how these mechanisms operate and therefore even less of an understanding of their limits. This project will use methods from information engineering, data science and neural networks to interpret data from an international Kavli foundation-funded collaboration (PI O'Leary and collaborator Prof Eve Marder, Brandeis University, USA) that studies the robustness of nervous systems and neural circuit dynamics in poikilotherms.

Neural circuits are particularly sensitive to temperature due to the strong sensitivity of neuronal biophysical properties on temperature. Our recent work in a canonical neural circuit of the crustacean stomatogastric ganglion has shown that core neural function is remarkably stable, despite large variation in biophysical properties of the components of the circuit. This PhD project will use existing data in tandem with new data as it is being gathered to build dynamic models of these circuits. Until recently this has proved challenging because we lacked appropriate methods to constrain models from data. Our recent work [Burghi, O'Leary & Sepulchre, CDC 2022] has surmounted many of these challenges using methods from control theory. This project will apply these methods to build data-driven models of temperature robust neural circuits, allowing us to identify underlying dynamics that enable temperature robustness and define its limits.

BBSRC DTP main strategic theme: Transformative technologies

BBSRC DTP secondary strategic theme: Understanding the rules of life, Bioscience for sustainable agriculture and food, Bioscience for renewable resources and clean growth