Research Groups & Labs

**Deconinck Research Group**

The main topic of my research is the study of nonlinear wave phenomena, especially with applications in water waves. I use analytical techniques ranging from soliton theory and partial differential equations to dynamical systems, perturbation theory and Riemann surfaces. The computational methods I use cover a wide range as well, from symbolic computation to continuation methods, data analysis and spectral methods.

**Kutz Research Group**

We develop data methods for reduced-order and equation-free modeling, machine learning, and compressive sensing for applications across the engineering, physical and biological sciences. We also leverage traditional applied mathematics expertise in nonlinear waves, scientific computing, perturbation and asymptotic methods, and bifurcation theory. Domain science research includes optics, neuroscience, computer vision, and fluid dynamics.

**LeVeque Research Group**

The LeVeque research group's research interests span many areas, including numerical analysis, computational fluid dynamics, nonlinear partial differential equations, mathematical theory of conservation laws, and software development, including the CLAWPACK software for solving conservation laws and other hyperbolic systems modeling wave propagation. It is also involved in research in many applications areas, including astrophysics, geophysics, and biophysics.

**Mathematical Ecology Group**

**Todorov Movement Control Laboratory**

The focus of our research is intelligent control in biology and engineering. We believe that the key to achieving dynamic intelligence is optimization. In biology, motor behavior is shaped by processes (evolution, learning, adaptation) that resemble iterative optimization. In engineering, perhaps the best way to build a truly complex controller that actually works is to specify a high-level performance criterion, and leave the details of the design process to numerical optimization. We are pursuing multiple lines of research spanning many traditional disciplines: control engineering, computer science, robotics, neuroscience, psychology, (bio) mechanics, applied mathematics. Despite their interdisciplinary nature, all these efforts are aimed at a common goal: understanding and synthesizing dynamic intelligence through learning and optimization.

**Shea-Brown Neural Dynamics Group**

The Neural Dynamics research group's interests span a wide set of topics in mathematical neuroscience and biological dynamics. Recent work focuses on optimal signal processing and decision making in simple neural networks, dynamics of neural populations in interval timing tasks, correlations and reliability in simple neural circuits, and properties of oscillator networks with generalized symmetries.

**Shlizerman Research Group on Data-driven Dynamical Systems**
Research in our group combines dynamical systems theory with data analysis to produce realistic data-driven dynamical models. Investigations are at the interface of development of generic computational approaches and modeling actual biological and physical systems. With the data-driven methodology Eli Shlizerman (PI) and members of the group are working on modeling neurobiological networks underlying insects' sensory systems and neural dynamics of organisms.

**Tung Research Group**
The focus of our research is intelligent control in biology and engineering. We believe that the key to achieving dynamic intelligence is optimization. In biology, motor behavior is shaped by processes (evolution, learning, adaptation) that resemble iterative optimization. In engineering, perhaps the best way to build a truly complex controller that actually works is to specify a high-level performance criterion, and leave the details of the design process to numerical optimization. We are pursuing multiple lines of research spanning many traditional disciplines: control engineering, computer science, robotics, neuroscience, psychology, (bio) mechanics, applied mathematics. Despite their interdisciplinary nature, all these efforts are aimed at a common goal: understanding and synthesizing dynamic intelligence through learning and optimization.

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