Center for Fluid Mechanics, Division of Applied Mathematics
Fluids and Thermal Systems Group, School of Engineering
Joint Seminar Series

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Optimal Motion in Fluids

Determining optimal kinematics is useful for both motion planning in robotics and for rationalizing and understanding movement in biological systems. In this talk, we apply a novel and general framework for determining optimal cyclic gaits, or strokes. Within the framework, we develop a kinematic model that relates a system's shape configuration to its external velocity and then exploit this model to visualize the system dynamics. We compare metrics for optimality of locomotion, including speed and efficiency in the context of this framework. We then find optimal strokes for multiple systems, including artificial swimming systems at low Reynolds number (a three link swimmer and Purcell's rotator) and a biological system dominated by inertia (a turning bat). In the case of the three link swimmer, we compare optimal strokes using Resistive Force Theory and Slender Body Theory. The latter theory is more accurate and accounts for interaction between the links, but is computationally more expensive. We then outline the conditions under which it is appropriate to use each theory. The general framework presented in this talk allows visualization of the relationship between shape configurations and external velocities, enabling a better understanding of system dynamics and improved optimization.

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4:00 PM
Barus & Holley, Room 190