Proceedings of the 2nd International Conference on Control, Dynamic Systems, and Robotics
Ottawa, Ontario, Canada, May 7 – 8, 2015

Geometric Mechanics in Aquatic Locomotion and Particle Manipulation

Scott Kelly
University of North Carolina at Charlotte
9201 University City Blvd,
Charlotte, NC 28223, United States
gscottkelly@gmail.com

The formalism of analytical mechanics on manifolds provides a natural setting in which to develop idealized models for systems comprising dynamically coupled bodies and fluids and facilitates the application of tools from dynamical systems theory and geometric nonlinear control to such models. Locomotion in fluids at the extremes of ideal flow and Stokes flow, for instance, may be described entirely in terms of geometric phases regulated by conservation laws derived from symmetries, while mechanisms for propulsive vortex shedding at intermediate Reynolds numbers may be framed in terms of integrable and nonintegrable velocity constraints. Models for the contact-free manipulation of fluid-borne particles via boundary actuation admit a similar perspective, and problems in the bulk transport and sorting of microparticles in water using vibrating cilia may be understood in terms of the regulation of bifurcation phenomena. This talk will describe theoretical, computational, and experimental research pertaining to biologically inspired systems for locomotion and particle manipulation in fluids with an emphasis on dynamic reduction, symmetry breaking, and related concepts.