

Graduate Student Research Seminar

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Modeling and control of internally actuated fish robot

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3:00 pm (EST) – 132 Fluor Daniel Building

Abstract



Developing autonomous bio-inspired fish robots requires accurate modeling and precise control of their complex locomotion dynamics. Internally actuated fish-like robots generate thrust through rapid oscillatory motion of an internal rotor coupled with a flexible tail, producing nonlinear fluid–structure interactions and gait-dependent propulsion. In this work, the robot is modeled as a hydrodynamic Chaplygin sleigh, with vortex-induced thrust approximated using nonholonomic constraints that incorporate added mass, buoyancy, and hydrodynamic damping. A computationally efficient 2D model with a multi-link flexible tail is developed to capture body–tail coupling and generate control-oriented data.

To address parameter uncertainty and limited experimental data, a teacher–student framework is adopted. The physics-based model serves as the teacher, while a Koopman-based data-driven model is recursively updated using experimental measurements. The resulting linear representation enables model predictive control for trajectory tracking and roll stabilization, providing adaptive and resilient performance in uncertain aquatic environments.



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