Graduate Student Research Seminar

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Underactuated gaits of a swimming robot with a bistable tail

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

Abstract

Over the past two decades, there has been a growing interest in the utilization of fish-like locomotion to enhance the propulsion and agility of underwater vehicles. Fish, with their superior capabilities in terms of speed, maneuverability, and locomotion efficiency, continue to outperform existing robotic counterparts. Some of the factors contributing to this are the presence of passive flexible appendages that have complex interactions with the fluid and the ability to tune the stiffness of their bodies in reaction to the surrounding flow. This enables fish to have multiple modes of motion or gaits that increase their maneuverability in difficult-to-navigate environments. This work presents an underactuated fish-like robot driven by an internal rotor coupled with a flexible bistable tail. This is inspired by recent work on internal rotor-driven robots with passive flexible tails. Such rotor-driven robots perform well in straight-line motion and are known for their smooth motion. However, with current architecture such robots are restricted in their turning capability and rotor saturation makes performing long turns challenging. We first design a robot with a bistable tail and perform experiments to demonstrate that by adding such a geometric bistability, the robot can perform straight-line gait by exciting inter-well oscillations of the tail, while exciting single-well oscillations gives it the ability to perform longer turns. We then model this bistable tail with the help of a canonical system like the parametric duffing oscillator. Finally, we test our duffing oscillator model with experimental data.

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