CPS: Medium: Collaborative Research: Towards optimal robot locomotion in fluids through physics-informed learning with distributed sensing

Bo Cheng and Asok Ray, Penn State; Cunjiang Yu, Univ. of Houston, Haibo Dong, Univ. of Virginia

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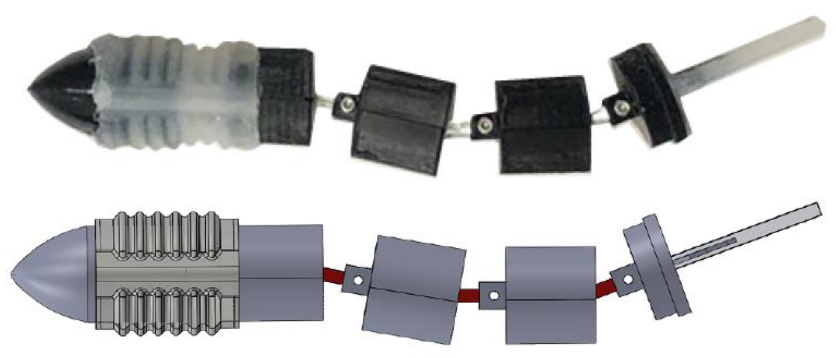

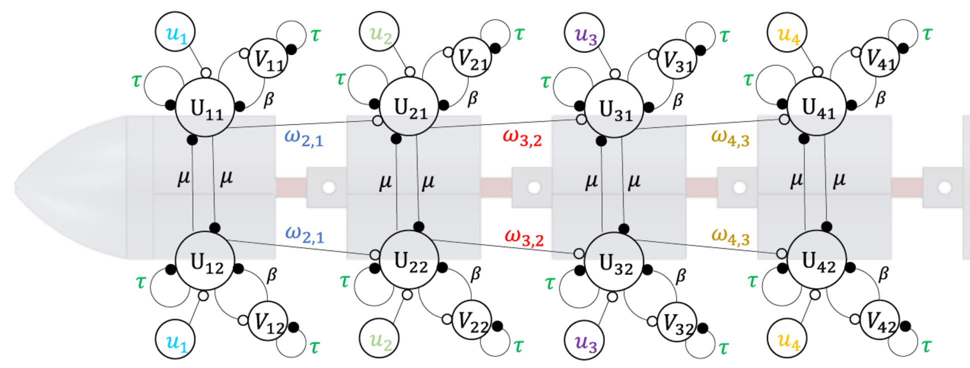

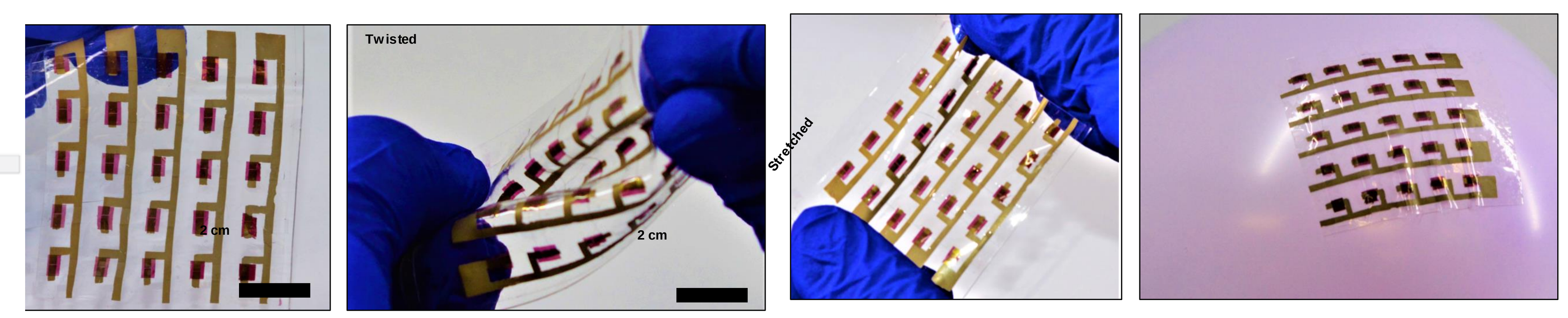

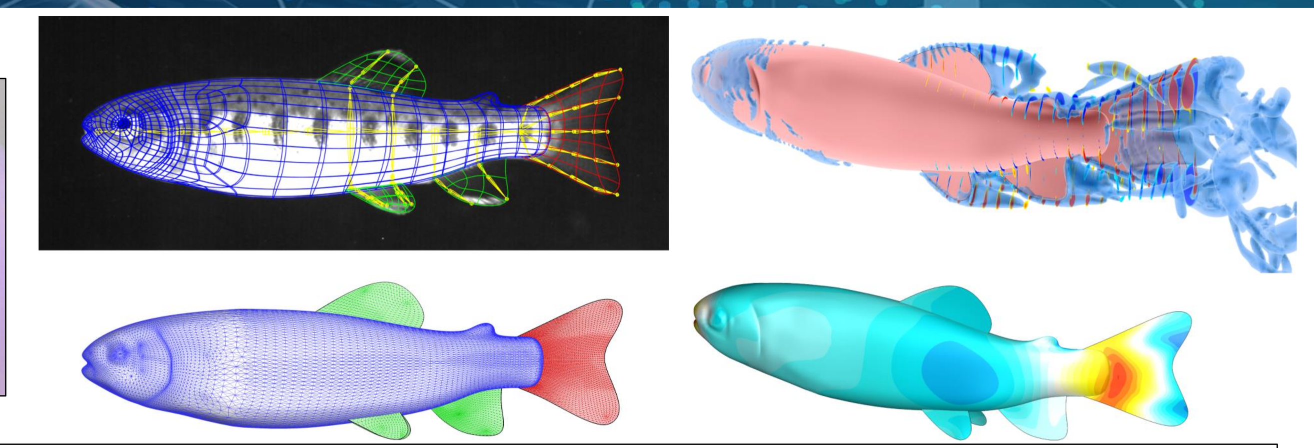

Challenge

- Highly complex forms of swimming (morphology and gaits)
- Coupled fluid dynamics and robot/fish body structural dynamics
- Perception of fluid environment with pressure feedback
- High density arrays of sensors in a skin format that mimics the biology counterpart

Scientific Impact

- Generate new knowledge on how to achieve data-efficient, physics-informed learning for robotic systems operating in complex environment
- Achieve stretchable electronic materials, intrinsically stretchable transistors and pressure sensors
- Understand fundamental interdependencies and interactions among robotic systems and the physics of fluids

Solution

- Modular robotic fish to explore large design space
- Reinforcement learning to explore robot gait and control in fluids
- Electronic skins with distributed stretchable sensors for perception
- Adaptive mesh refinement high performance computing for complex fluids problems in a wide range of Reynolds numbers

Broad Impact (Society)

- Water and environment monitoring, healthcare, defense, space
- CPS areas: control, data analytics, autonomy, design, and real-time systems
- both engineering and biology communities

Broad Impact (education and outreach)

- Create tools for STEM education
- Inclusion of unrepresented students (3 African American, 2 Female, 1 Hispanic)

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