Materializing Autonomy in Soft Robots Across Scales

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Abstract:

The impressive capabilities of living organisms arise from the way autonomy is materialized by their bodies. Across scales, living beings couple computational or cognitive intelligence with physical intelligence through body morphology, material multifunctionality, and mechanical compliance. While soft robotics has advanced the design and fabrication of physically intelligent bodies, the integration of information-processing capabilities for computational intelligence remains a challenge. Consequently, perception and control limitations have constrained how soft robots are built today. Progress toward untethered autonomy will require deliberate convergence in how the field develops new materials, fabrication methods, and control strategies for soft robots.

In this talk, I will present our lab's latest materials and methods for achieving electrically driven soft robots from architected materials. First, I will introduce 3D printed architectures called handed shearing auxetics (HSAs) for use as motorized soft actuators. I will then introduce approaches for simplifying HSA operation through soft torque transmission systems and 3D printing soft architected robots from recyclable thermoplastic elastomers. Finally, I will discuss opportunities for using these systems for untethered locomotion and other embodiments of robotic materials that afford physical and computational intelligence.

Short Biography:

Ryan Truby is the June and Donald Brewer Junior Professor of Materials Science and Engineering and Mechanical Engineering at Northwestern University. His research broadly aims to advance machine intelligence by material design. He and his team in the Robotic Matter Lab are currently developing novel soft actuators and sensors, rapid multimaterial 3D printing methods, and machine learning-based control strategies for soft sensorized robots. Ryan's research also includes work in 3D printing vascularized tissue constructs, soft electronics, artificial muscles, and architected materials. Before Northwestern, Ryan was a Postdoctoral Associate at MIT's Computer Science and Artificial Intelligence Lab, and he received his Ph.D. from Harvard University. Ryan is the recipient of a DARPA Young Faculty Award, Office of Naval Research Young Investigator Award, Air Force Office of Scientific Research Young Investigator Award, the Outstanding Paper Award at the 2019 IEEE International Conference on Soft Robotics, an Inaugural 2018 Schmidt Science Fellowship, and the Gold Award for Graduate Students from the Materials Research Society.