Polymer Program

INSTITUTE OF MATERIALS SCIENCE

Seminar: 11:10 am Friday, April 7

Science 1: Room 1002

Host: Xueju Wang

Ruike Renee Zhao

Soft Intelligent Materials

Stanford University

Multifunctional Origami Robots

Abstract: In this talk, I will introduce our recent work on origami mechanisms and actuation strategies for applications spanning from biomedical devices to foldable space structures. The first topic is magnetically actuated millimeter-scale origami medical robots for effective amphibious locomotion in severely confined spaces or aqueous environments. The origami robots are based on the Kresling origami, whose thin shell structure 1) provides an internal cavity for drug storage, 2) permits torsion-induced contraction as a crawling mechanism and a pumping mechanism for controllable liquid medicine dispensing, 3) serves as propellers that spin for propulsion to swim, 4) offers anisotropic stiffness to overcome the large resistance from the severely confined spaces in biomedical environments. For the second part of my talk, the concept of hexagonal ring origami folding mechanism will be introduced as a strategy for deployable/foldable structures for space applications. The hexagonal rings can tessellate 2D/3D surfaces and each ring can snap to its stable folded configuration with only 10.6% of the initial area. Through finite-element analysis and the rod model, snap-folding of the hexagonal ring with slight geometric modification and residual strain are studied for easy folding of the ring to facilitate the design and actuation of hexagonal ring origami assemblies for functional foldable structures with extreme packing ratio.

Bio: Renee Zhao is an Assistant Professor of Mechanical Engineering at Stanford University. Renee received her PhD degree in Solid Mechanics from Brown University in 2016. She spent two years as a postdoc associate at MIT working on modeling of soft composites. Before Renee joined Stanford, she was an Assistant Professor at The Ohio State University from 2018 to 2021. Renee's research concerns the development of stimuli-responsive soft composites and shape morning mechanisms for multifunctional robotic systems. Renee is a recipient of the NSF Career Award (2020), AFOSR YIP (2023), ASME Journal of Applied Mechanics award (2021), the 2022 ASME Pi Tau Sigma Gold Medal, and the 2022 ASME Henry Hess Early Career Publication Award.