

Research Seminar

Dr. Mahnoush Babaei

Carnegie Mellon University

“Integrated Design with Smart Materials and Bio-Inspired Structures”

Abstract

Untethered small-scale robots (ranging from millimeters to nanometers) lend themselves well for applications in complex environments and enclosed spaces such as agricultural inspection and monitoring, biopsy in the human body, and navigating the rubble in disaster relief missions. However, the design of these robots is challenging and fundamentally different from the design of conventional robotic systems. Traditional robots are assembled from discrete components such as structural links, sensors, actuators, and controllers. In small-scale robots these functional elements need to integrate tightly within a small structure. Biological systems and smart materials are promising resources for addressing these challenges due to their highly integrated nature. In this talk, I will lay out an interdisciplinary approach that spans novel smart materials, structural designs, and biological systems for creating untethered, fast, and efficient devices for robotic applications. To this end, I will first present application of photo- and heat-responsive Liquid Crystalline Polymers (LCPs) to create a variety of soft active mechanisms in the context of untethered autonomous designs. I will then discuss an approach for achieving autonomy by increasing the work density of actuators. This approach uses thin film Shape Memory Alloys and additive manufacturing techniques and can be utilized in sub-mm scale multifunctional robots. Finally, I will present computational models to understand the spatiotemporal pattern of strain over a moth wing during normal and disturbed flight. These models facilitate efficient placement of bioinspired strain sensors on the wing for agile flight of unmanned aerial vehicles.

Biography

Dr. Mahnoush Babaei received her B.Sc. in Civil Engineering in 2010 from Ferdowsi University of Mashhad, Iran, followed by an M.Sc. in Civil Engineering – Structure in 2013 from Sharif University of Technology, Tehran, Iran. She received her second M.Sc. degree in Civil and Environmental Engineering and her Ph.D. in Computational Mechanics from Carnegie Mellon University, Pittsburgh, in 2018 and 2019, respectively. During her Ph.D., she received multiple awards including Neil and Jo Bushnell Fellowship and Outstanding Teaching Assistant Award. Currently, she is a postdoctoral research associate in Mechanical Engineering at Carnegie Mellon University, working on a collaborative research to study mechanosensory structures in insect wings and to design bioinspired sensors for agile flight in UAVs. Her research lies in the intersection of smart materials, bioinspired designs, and small-scale robotics through a healthy balance of computational modeling and experiments. She co-organized the Rising Stars Workshop for female researchers in Civil and Environmental Engineering in 2020.



Tuesday, April 20, 2021

9:00 a.m. – 10:30 a.m.

Register in advance for this meeting:

<https://psu.zoom.us/j/6tceiqqTnsGtao2V2Str7PFGPmJHHz744Y>

After registering, you will receive a confirmation email containing information about joining the meeting.

For additional details call Diane K. Bierly 814-863-6491