ME Seminar

Soft robotic actuators: mechanical engineering principles for bioengineering applications

Dr. Debkalpa Goswami
Director of Biomechanics, Cleveland Clinic
Assistant Professor of Medicine, Case Western Reserve University

ABSTRACT

Soft robotics is a subfield of robotics that concerns the design, control, and fabrication of robots composed of compliant materials, instead of rigid links. In contrast to rigid-bodied robots built from metals, ceramics and hard plastics, the compliance of soft robots can improve their safety when working in close contact with humans. The growing field of soft robotics provides an ideal opportunity for the development of implantable devices and simulation testbeds due to the constituent materials of these robots possessing mechanical properties comparable to biological tissue. Soft robotic devices are pushing the boundaries of robotics in accomplishing tasks that are out of the reach of traditional rigid body systems. In this talk, I will present some of our team's recent work that leverages soft robotic technology to build both benchtop and in vivo models of cardiovascular disease. I will also discuss novel implantable soft robotic drug delivery devices with potential applications in the treatment of diabetes. I will explore how these platforms can be harnessed to simulate disease progression, enabling more accurate and personalized treatment strategies.

ABOUT THE SPEAKER

Debkalpa Goswami is a faculty member in the Department of Cardiovascular Medicine at Cleveland Clinic, Ohio, USA, where he also serves as Director of Biomechanics at the Cardiovascular Innovation Research Center, and is affiliated with the Heart, Vascular, and Thoracic Institute. He is also an Assistant Professor of Medicine at Case Western Reserve University. Debkalpa is originally from Kolkata, and received his Bachelor's degree in Production Engineering from Jadavpur University in 2015. He was awarded the European Commission's Erasmus Mundus Fellowship in 2013, and spent a year as a guest researcher at the University of Bremen, Germany. He joined Purdue University, USA, on a Ross Fellowship in 2015 and obtained his PhD in 2020 for his thesis "Design and Manufacturing of Flexible Optical and Mechanical Metamaterials". In 2020, Debkalpa received the Marie Curie Fellowship from the European Commission, but eventually declined it to pursue postdoctoral research in Medical Engineering at Massachusetts Institute of Technology, USA, where he was also part of the Harvard-MIT Division of Health Sciences and Technology. After completion of postdoctoral training in 2022, Debkalpa had a brief stint as a Senior Scientist at ETH Zurich, Switzerland, before joining Cleveland Clinic and Case Western as a faculty member in 2023. Debkalpa's research is multi-disciplinary and combines soft robotics, 3D printing, biosensing tools, and computational modeling to build advanced physical and digital biomechanical models of disease. He has authored over 30 publications in leading journals including Nature Biomedical Engineering, Science Robotics, Nature Communications, and Advanced Materials. His research has also been widely covered by international media outlets including CNN, NBC News, Bloomberg, and New York Post, and by popular Indian outlets such as The Economic Times, The Hindu, India Today, Hindustan Times, and the Deccan Chronicle.

November 24, 2023 (Friday)
4:00 PM, A.R. Auditorium