SE 290 SEMINAR

ACTIVE ARCHITECTED MATTER WITH EMBEDDED INTELLIGENCE

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Warren Lecture Hall 2204
12:00 - 12:50 PM

ZOOM

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UC San Diego
JACOBS SCHOOL OF ENGINEERING
Structural Engineering

Abstract

There is an unceasing quest to create novel forms of intelligent active matter that exhibits sensing, energy harvesting, actuating, computing, and communication functionalities. Realizing such capabilities can provide new road maps to autonomous and electronic materials with numerous applications in robotics, human-machine interfacing, micro/nano-electromechanical systems, and flexible electronics. In this talk, I will introduce the striking concept of "mechanical metamaterial electronics (meta-mechanotronics)" as a platform for designing intelligent matter that can sense external stimuli, self-power and process the information to create an integrated closed-loop control system. I will explain how we can achieve these advanced functionalities by fusing the mechanical metamaterials, digital electronics and triboelectric nano energy harvesting technologies. I will discuss the mechanisms, fabrication processes and computational frameworks required to create novel classes of active and multifunctional electronic mechanical metamaterials under the meta-mechanotronics concept. The envisioned electronic mechanical metamaterials use only their constituent components and the integrated contact-electrification mechanisms for sensing and information processing operations. Thus, they establish a direct interaction mechanism between the external environment and electronics. Incorporating all of these functionalities into the fabric of materials could in theory lay the foundation for autonomous materials and structures that respond to their environment, monitor their condition and process the sensed signals. I will explain how insights into the mechanics, design, and implementation of the scale-independent metamechanotronic systems can be shared among disciplines ranging from micro/nano-electromechanical systems to large-scale civil structures.

Biography

Dr. Amir H. Alavi is an Assistant Professor in the Department of Civil and Environmental Engineering, and holds a courtesy appointment in the Department of Bioengineering at the University of Pittsburgh. He is the director of the Intelligent Structural Monitoring and Response Testing (iSMaRT) Laboratory at Pitt. His multidisciplinary scientific studies are organized around three research thrusts: 1) Multifunctional materials and intelligent structures, 2) Self-powered sensing systems, and 3) Data-driven characterization, design and discovery of engineering systems. Dr. Alavi is passionate about advancing the science of systems engineering to create integrative approaches for the design, operation and analysis of complex engineering systems. He is interested in harnessing the power of the created principles and concepts in the fields of civil infrastructure, construction, aerospace, and biomedical engineering. In addition, Dr. Alavi's original and seminal contributions to developing and deploying advanced machine learning and bio-inspired computational techniques have established a road map for their broad applications in various engineering domains. Dr. Alavi is among the Web of Science ESI's World Top 1% Scientific Minds in 2018, and Stanford University list of Top 1% Scientists in the World in 2019 and 2020.