Department of Electrical and Computer Engineering

Materials Engineering Program

Texas Center for Superconductivity at Univ. of Houston

Center for Integrated Bio and Nano Systems

10:00 a.m., Feb. 4, 2022

CBB 122

Spatial variations in programmable meta-materials

Tian "Tim" Chen

Kamal Salama assistant professor

Department of Mechanical Engineering

The University of Houston

Abstract: Metamaterials are designed to realize exotic physical properties through the geometric arrangement of their underlying structural layout. The design of metamaterials often imposes the following constraints a priori: 1) unit cells must be identical and can be tiled indefinitely, 2) once fabricate, the properties of the metamaterial shouldn't change. In this talk, I explore the rich design space afforded when we relax these constraints, and discuss how we encode spatial variation and/or on-demand programmability. In Bistable Auxetic Surface Structures, we aim to design a meta-surface with spatially varying unit cells that when deployed, transforms to a desired target shape. The geometric mapping between 3D and 2D exploits the unique characteristics of isotropic deformation of certain Kirigami geometries. The resulting surfaces are stable after deployment and can be applied to a number of engineering applications at different length scales. Next, to address mechanical reprogrammability, we draw analogy to that of digital devices in which each unit can be written to or read from on-the-fly. Specifically, we propose a mechanical metamaterial with stable memory at the unit-cell level. Our design comprises an array of physical binary elements with clearly delineated writing and reading phases. Each m-bit can be independently and reversibly switched between two stable states using magnetic actuation. We expect this design paradigm to facilitate the development of novel forms of metamaterials.

Short Bio: Tian “Tim” Chen is the Kamal Salama assistant professor at the University of Houston. Since joining UH in Sept. 2021, he established the Architected Intelligent Matter Laboratory to explore the notion of intelligent metamaterials. In particular, he aims to design materials that can either transfer their shape or their physical characteristics on-demand. With such metamaterials, his goal is to provide a bridge between passive materials and powered robotics. Thus far, he has received a grant from AMI at UH, as well as three PURS scholars. His read Engineering Science as an undergraduate at the University of Toronto, M.Sc. in civil engineering from Delft University of Technology, and PhD in mechanical engineering from ETH Zurich where he received the ETH Medal in 2018. He was most recently a post-doctoral scientist at EPFL.