

ARMA Future Leader Webinar Series

Every Two Weeks on Fridays 9-10 am MT (11 am – 12 pm ET)

Multiscale Modeling of Coupled Mechanisms in Geomechanics

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Friday, December 13, 2024, 9-10 am MT (11 am – 12 pm ET)

<https://us06web.zoom.us/j/87132464009>

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Abstract

Natural and engineered composites, including soils, rocks, woods, tissues, and concrete, exhibit complex behaviors driven by multiscale interactions. These behaviors are vital for understanding infrastructure performance, construction materials, sustainable practices, natural disaster mitigation, and energy resource exploration. This talk focuses on multiscale modeling, presenting a mathematical framework that connects microscopic properties to macroscopic material responses. Starting with an overview of multiscale modeling, the discussion delves into homogenization theories addressing the coupling of dislocation glide and pressure solution in polycrystals. Using halite as a model material, the conditions necessary for mechanical healing are examined within a self-consistent homogenization framework. This model applies Eshelby's solution to problems combining mechanical deformation and diffusive mass transfer. The talk further investigates the impact of weathering on damage propagation and fracture trajectories in granite, Earth's most ubiquitous polymineralic rock. The continuum model derived from homogenization is implemented in the Finite Element Method (FEM) to simulate landscape evolution with and without fracture propagation. These simulations demonstrate how the model can elucidate the influence of mineral weathering on Critical Zone evolution. The presentation will conclude by highlighting prospective developments in the field of multiscale and multiphysics models.

Biography

Dr. Tingting Xu is a postdoctoral fellow currently affiliated with the Hopkins Extreme Materials Institute at Johns Hopkins University, working with Dr. Vicky Nguyen on polymer mechanics and Dr. James Guest on topology optimization. In Spring 2025, she will join the Department of Civil Engineering at McMaster University as a tenure-track assistant professor. Prior to joining JHU, Tingting earned her Ph.D. from Georgia Institute of Technology under the guidance of Dr. Chloé Arson, focusing on the multiscale modeling of multiphysical processes in geomaterials. She also holds a Master's degree in Computational Science and Engineering from Georgia Tech.

