



**Somnath Ghosh, PhD**  
John Hopkins University

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4:00 PM – 5:00 PM (EST)  
**AIM EFRC Webinar Series**  
(Season 4)

## Modeling Damage in Piezocomposites: A Digital Twin Approach



**Abstract:** Tracking structural damage under challenging conditions is essential for structural health monitoring (SHM) to improve reliability and prevent costly failures. Traditional SHM methods are often post-mortem, relying on sparse surface sensors that detect only surface or near-surface damage, missing subsurface evolution. This talk presents Virtual Damage Sensing Digital Twin (VDS-DT) for piezoelectric composites. The platform integrates multiscale-multiphysics modeling, microstructure representation, and a Fourier neural operator (FNO) to predict full-field damage in real time from optimally placed surface sensors. Key components include: (i) a Parametrically Upscaled Coupled Constitutive Damage Model (PUCCDM) with coefficients derived from Representative Aggregated Microstructural Parameters (RAMPs), (ii) a PUCCDM-trained FNO that fuses RAMP fields with sparse electric measurements to reconstruct electromechanical and damage fields in arbitrary geometries, and (iii) genetic algorithm-optimized sensor layouts. The VDS-DT delivers spatio-temporal damage predictions across scales with minimal sensors, demonstrating its potential as a scalable, real-time SHM tool.

**About Dr. Ghosh:** Professor Somnath Ghosh is the Michael G. Callas Chair Professor in the Department of Civil & Systems Engineering and Professor of Mechanical Engineering and Materials Science & Engineering at Johns Hopkins University. He is the founding director of the JHU Center for Integrated Structure-Materials Modeling and Simulation (CISMMS). He is currently the co-director of NASA STRI Institute for Model-based Qualification and Certification of Additive Manufacturing (IMQCAM) and was the director/PI of the Air Force Center of Excellence in Integrated Materials Modeling (CEIMM). His research focuses on multi-scale structure-materials analysis and simulations, multi-physics modeling and simulation of multi-functional materials, materials characterization, process modeling, and emerging fields like Integrated Computational Materials Engineering (ICME).

Location: Virtual – Zoom Meeting. Join on your computer, mobile app, or room device

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