CASE WESTERN RESERVE UNIVERSITY

CIVIL AND ENVIRONMENTAL ENGINEERING DEPARTMENT SEMINAR & CASE ADVANCEMENT FELLOWS

DR. SOMDATTA GOSWAMI
Assistant Professor
Department of Civil and Systems
Johns Hopkins University

Date: Thursday, December 12th, 2024
Time: 4:00pm – 5:00pm EST
Location: Vose, Room 138
Zoom link: here

Scientific Machine Learning for Real-Time Physical System Inference: Bridging Physics and Observation

Abstract: The convergence of data-driven approaches with physics-informed deep learning architectures represents a transformative shift in scientific computing and engineering analysis. This emerging paradigm, known as "scientific machine learning" (SciML), offers a powerful framework for synthesizing partial theoretical knowledge with limited observational data to enhance understanding of complex physical systems. The research presented will demonstrate how SciML can effectively bridge the gap between idealized physical models and real-world observations, particularly in scenarios with incomplete constitutive relationships or closure terms. While traditional methods often struggle with real-time inference in data-sparse environments, my work introduces novel approaches that leverage functional and operator regression within deep learning architectures to address these challenges. Drawing from applications in mechanics like capturing responses during a natural hazard, failure of materials, and climate modeling, the presentation will showcase how these methods achieve both computational efficiency and physical consistency - crucial requirements for practical engineering applications. The presentation will detail specific contributions to the field, highlighting cases where SciML has enabled real-time prediction capabilities previously considered intractable using conventional numerical methods.

Bio: Somdatta Goswami is an Assistant Professor at the Department of Civil and Systems and holds a joint appointment with the Department of Applied Mathematics and Statistics. She is also an affiliate member the Hopkins Extreme Materials Institute at the Johns Hopkins University. Her research interests span Scientific Computing, Computational Mechanics, and Machine Learning, focusing on both fundamental and applied aspects. Her work addresses long-time horizon problems and challenges in multi-scale, multi-physics material modeling. Dr. Goswami is particularly dedicated to developing AI-accelerated numerical simulations, aiming to enhance the efficiency of numerical solvers as well as accuracy of machine learning predictions, for problems in solid mechanics.