April 26, 2024

Modeling Interface Interactions in Complex Structures and Materials: Challenges and Opportunities

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Seminar Details

Friday, April 26, 2024
2:30pm – 4:00pm

UH Campus
Science Building
Room S105

Online via Teams
https://www.cive.uh.edu/research/beyer-distinguished-lecture

ABSTRACT: The discipline of computational mechanics has witnessed significant advancements that have greatly improved our ability to model complex phenomena, ranging from large-scale engineering and nanoscale systems to environmental and economic processes. With improved methods and more powerful computing, it has become possible to gain new insights into the behavior of civil, mechanical and biomechanical systems under conditions that cannot be replicated in a laboratory, and often at reduced cost compared to experimental testing. Many challenges, however, remain in the development of computational models for complex infrastructure systems and composite materials where multiple components interact through an interface. Interfaces are critical pathways for load-carrying mechanisms that contribute to life-long performance and structural resilience, and it is crucial for the computational model to capture the interface kinematics and force transfer processes accurately, particularly in the presence of geometric and material nonlinearities, damage and friction.

This presentation discusses the challenges and applications of interface modeling for coupled problems in engineering. I will introduce a new class of interface formulations that can efficiently handle complex interactions with large deformations, plasticity and friction, and that supports the multi-scale simulation of composite materials. I will present example applications where physics-based computational modeling of interface interactions leads to accurate prediction of bond behavior in materials such as reinforced concrete and reveals new insights into test standards and damage retardation techniques. These new and robust interface formulations enable the modeling of complex structures for purposes of health monitoring and life-cycle management and open exciting opportunities for the development of emerging materials and novel approaches for enhanced structural resilience.

BIOGRAPHY: Ghadir Haikal is an Associate Professor in Structural Engineering and Mechanics in the Department of Civil, Construction and Environmental Engineering at North Carolina State University. She holds a Bachelor's degree in Civil Engineering from Tishreen University, Syria and M.S. and Ph.D degrees from the University of Illinois at Urbana-Champaign, also in Civil Engineering. Prior to her current position, Dr. Haikal led the Computational Materials Integrity group in the Department of Materials Engineering at Southwest Research Institute (SwRI) and was an Assistant Professor of Civil Engineering at Purdue University. Dr. Haikal's research focuses on developing advanced computational models for complex structures and composite materials. She is a Fulbright Fellow and is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Society of Engineering Science and the United States Association for Computational Mechanics.