MICHIGAN STATE UNIVERSITY
Department of Statistics and Probability

COLLOQUIUM

Mohsen Zayernouri
Michigan State University

Uncertainty Quantification for System-Level Fractional Modeling, Simulation, and Analysis

Tuesday, January 21, 2020
10:20 AM - 11:10 AM
Refreshments 10:00 AM
C405 Wells Hall

Abstract

Out of the box approaches are required to better understand complex phenomena such as anomalous transport, aging materials, and life-cycle prediction of systems. In fact, the classical mathematical models have been already pushed to their limits, and they are no longer adequate to describe the emergent phenomena of the twenty-first century with enough fidelity. We propose adopting a fresh modeling, simulation, and analysis (MSA) perspective, founded by the use of Fractional Calculus. The extensive applications are aging materials, anomalous rheology, thermo-electro-mechanical material damage due to fatigue, in addition to non-Gaussian transport phenomena. Our particular MSA approach, which will promisingly lead to the 'System-Level' MSA fidelity enhancement, in fact originates from our new learning and Uncertainty Quantification (UQ) approach. Both of the underlying physics and mathematical models are allowed to evolve in 'nature' and 'form', giving rise to integer (standard)-to-fractional (anomalous) models in space-time, given available multi-modal (belonging to a system of physical systems) experimental data and gives rise to paradigm-shifts in experimental studies and the way we look at even existing data. In multi-physics and system-level MSA, this is a significant portion/contribution of total uncertainty that has not been properly addressed in current state-of-art UQ techniques.

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