Texas Tech University
Department of Chemical Engineering
Seminar Schedule

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Rapid and Accurate Uncertainty Propagation and Safety Verification in Chemical, Aerospace, and Robotic Systems

Abstract
Driven by advances in automatic control, information technology, and robotics, tasks as diverse as chemical manufacturing and space exploration are increasingly done by complex integrated systems with significant autonomy. Although such systems often achieve tremendous gains in efficiency and flexibility, their complexity makes them increasingly prone to malfunctions arising from errors in control logic, unexpected responses to uncertain factors in their operating environments, component failures, and even cyber-attacks. This has led to a critical need within the advanced control community for algorithms that can (i) rigorously characterize the effects of uncertainty in complex systems, (ii) use this information to verify safety and correct behavior under all plausible scenarios prior to deployment, and (iii) rapidly and accurately detect faults during operation.

This talk will present our recent progress on the first two of these three problems. First, we will discuss algorithms for efficiently propagating the effects of uncertain parameters and inputs through nonlinear dynamic models, leading to tight, rigorous bounds on all possible solutions. Next, new algorithms will be presented for safety verification based on our new uncertainty propagation techniques. Finally, the improved speed and accuracy of these algorithms relative to state-of-the-art methods will be demonstrated through examples in chemical process safety verification, pharmaceutical design space construction, and aircraft collision avoidance.

Bio:
Joseph K. Scott is an Associate Professor in the Department of Chemical and Biomolecular Engineering at the Georgia Institute of Technology. He received his B.S. (2006) in Chemical Engineering from Wayne State University, and his M.S. (2008) and Ph.D. (2012) in Chemical Engineering from MIT. His honors include the 2012 Best Paper Award from the Journal of Global Optimization, the 2016 W. David Smith, Jr. Award from the Computing and Systems Technology Division of the AIChE, the 2014-2016 Automatica Paper Prize from the International Federation of Automatic Control, and the 2016 Air Force Young Investigator Research Program Award. His research interests include process modeling and simulation, dynamical systems, optimization theory, and advanced process control. Current application areas include adsorption and membrane processes, downstream processing of biologics, optimal design and operation of wind and solar energy systems, power grid operations, and robot motion planning.

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3:00 pm