October 23, 2026

Sparse Structural System Identification Algorithms: Data-Driven and Physics-Informed Models from Advanced Sensing

Beyer Distinguished Lecture

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ABSTRACT: This lecture presents novel methods and algorithms developed for solving critical challenges in sparse structural system identification and inverse modeling. These methods focus on discovering both data-driven and physics-informed models and address linear and nonlinear systems using sparse regularization (L1 and LS with thresholding), data fusion, and sparsity-promoting Kalman filtering. A key highlight is the integration of Machine Learning (ML) and Artificial Intelligence (AI) to bridge the gap between data discovery and physical laws, enabling the extraction of governing ODE/PDE equations directly from input-output maps. The efficacy of these methods is validated through experimental data across linear, time-varying, and nonlinear hysteretic systems. Finally, the practical utility of these algorithms is demonstrated by assessing the performance of base-isolated structures during major recorded seismic events in Los Angeles. A brief description at the end focuses on advanced noncontact laser-based strain sensing and mapping, comprising the strain sensing smart skin used for measuring the data needed for damage identification.

Seminar Details

Friday, October 23, 2026
2:30pm – 4:00pm

UH Campus Classroom and Business Building Room CBB 118

Online via TEAMS https://www.cive.uh.edu/research/seminars

BIOGRAPHY: Dr. Satish Nagarajaiah is a Professor of Civil and Mechanical Engineering at Rice University, Houston. His research resides at the intersection of structural dynamics, seismic isolation, adaptive systems, sensing, and sparse system identification, with a current focus on physics-informed Machine Learning and AI. He has published over 400 papers and two books while mentoring a generation of doctoral students who now hold prominent faculty positions worldwide. Professor Nagarajaiah's leadership in the field includes serving as Managing Editor of the ASCE Journal of Structural Engineering and holding senior editor roles for Structural Control and Health Monitoring (Wiley) and Mechanical Systems and Signal Processing (Elsevier). His seminal contributions have earned him the NSF CAREER Award, the ASCE Moisseiff Award, and the ASCE Raymond Reese Research Prize. Most notably, he was honored with the 2020 Nathan M. Newmark Medal by the ASCE Structural Engineering and Engineering Mechanics Institutes and the 2025 George W. Housner Structural Control and Monitoring Medal. A Fellow of the National Academy of Inventors and a Distinguished Member of ASCE, he continues to bridge the gap between algorithmic innovations, practical inventions, and applications, while aiming to create more resilient urban infrastructure.