Nonlinear Model-Data Fusion for Post-Earthquake Assessment of Instrumented Buildings

Abstract

Establishing a systematic and efficient methodology for determining the safety and readiness of buildings for reoccupancy after an earthquake is crucial for ensuring the seismic resilience of communities. Recent seismic events in Turkey (2023) and Puerto Rico (2020) have highlighted the need to address similar challenges in earthquake-prone areas worldwide. This seminar aims to address this need by developing and implementing a nonlinear model-data fusion approach for post-earthquake assessment in instrumented buildings. The objective is to utilize vibration measurements to estimate response quantities that impact the extent of damage and building functionality. The main contribution of this seminar is the introduction of an extended model-based observer that combines a mechanics-based nonlinear model with sparse global vibration measurements to extract physically and structurally meaningful information. This information includes the complete dynamical response, inter-story drifts, demand-to-capacity ratios, and dissipated strain energy, which are crucial for structural integrity assessment. Three case studies of experimental and real-world instrumented buildings made of steel, reinforced concrete, and wood-frame are presented to validate the effectiveness of the proposed approach. By employing this approach, engineers and officials can make more informed assessments of structural systems, facilitating functional recovery in seismic-prone communities.

Bio

Dr. Milad Roohi is an Assistant Professor in the Charles W. Durham School of Architectural Engineering and Construction at the University of Nebraska-Lincoln and the director of the SiRIUS lab. His lab's research focuses on enhancing infrastructure and community resilience through multi-disciplinary data and algorithms, computational models, and emerging technologies. Before joining UNL, Dr. Roohi worked as a Senior Scientist at Aon in the Impact Forecasting R&D Center of Excellence, specializing in seismic catastrophe risk modeling for the Caribbean region and United States. Dr. Roohi's completed his Postdoctoral Fellowship at the NIST Center for Risk-Based Community Resilience Planning at Colorado State University and his research focused on enhancing community resilience and engagement with US communities. He contributed to developing the IN-CORE platform and improving the tools available for community resilience assessment and planning. Dr. Roohi received his Ph.D. in Civil Engineering from the University of Vermont, with a focus on performance-based seismic structural health monitoring. He actively contributes to several technical committees, including ASCE Structural Health Monitoring & Control (SHMC), Dynamics, and Objective Resilience committees, as well as IABSE Task Group 1.8.