PacTrans Presents

Automating Bridge Condition Assessment with Robotics and AI

With Genda Chen, PhD

THURSDAY
06.04.26

Gates Center 387 (UW)
2:00 - 3:00PM PT
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Abstract

This presentation presents an integrated approach to automating bridge condition assessment using robotics and artificial intelligence through a multi-step framework. First, drones, crawlers, and hybrid robotic systems enable remote sensing, capturing comprehensive video datasets and conducting aerial nondestructive testing to collect mission-critical data. Next, representative frames are extracted from inspection videos using histogram-based image filtering and analyzed with a multitask High Resolution Network (HRNet) to detect and segment structural defects.

The identified defects are then quantified using distance-calibrated imagery and Structure-from-Motion (SfM) techniques for 3D reconstruction. Subsequently, the condition state of bridge elements is determined by comparing detected defect types and their severity with reference images from the 2019 Manual for Bridge Element Inspection.

To support this framework, a custom BridgeNet dataset was developed with dual labels for both structural elements and defects. Class imbalance was addressed using weighted loss functions and task-specific data augmentation during HRNet training. The resulting multitask model demonstrates strong performance in accurately segmenting both defects and structural elements, while SfM provides reliable measurements.

Finally, the proposed approach was validated on five bridges in Missouri, demonstrating its practicality and its ability to improve inspection efficiency and result consistency.

Meet the Speaker

Dr. Genda Chen is Professor and Abbett Distinguished Chair in Civil Engineering and Director of the Center for Intelligent Infrastructure at Missouri University of Science and Technology. He has authored or co-authored over 550 technical publications in structural health monitoring (SHM), structural control, computational and experimental mechanics, life-cycle assessment and deterioration mitigation of infrastructure, and multi-hazards assessment and mitigation. He delivered 29 keynote/invited presentations at international conferences and workshops. He chaired the 9th International Conference on Structural Health Monitoring of Intelligent Infrastructure (SHMII-9), St. Louis, Missouri, August 4-7, 2019. He is a fellow of five professional organizations, including American Society of Civil Engineers (ASCE) and International Society of Civil Structural Health Monitoring (SCSHM). He received the 2025 ASCE Charles Pankow Award for Innovation, the 2025 SCSHM Aftab Mufti Lifetime Achievements Award, the 2019 SHM Person of the Year Award from the International Workshop on Structural Heatlh Monitoring, and the 1998 National Science Foundation CAREER Award.

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