



## Automated Bridge Inspection, Element Segmentation, and Defect Classification

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### **Abstract:**

In recent years, bridge inspection data has been increasingly used to support a more proactive approach of asset management such that structures are not only safe but also maintained for a minimal life-cycle cost. The broadening of inspection scope requires a significant shift in practice from fully visual inspection to partially visual inspection supplemented with advanced technologies such as drone-based remote sensing and nondestructive testing. This seminar will summarize the new development and deployment of Bridge Inspection Robot Deployment Systems (BIRDS) for high-quality inspection tasks and explainable artificial intelligence (AI) models for element segmentation and defect classification. BIRDS include: (1) A hybrid flying and traversing vehicle is attached to bridge girders as a stationary platform to inspect bridge decks (underside), girders, and piers, collect visible and thermal images, and launch a small lightweight crawler for microscopic steel weld inspection; (2) An unmanned aerial vehicle (UAV) is equipped with an aerial manipulator for nondestructive testing such as active thermography for concrete crack detection and depth determination; and (3) A hybrid swimming and roving vehicle is equipped with a sonar system to scan piers and foundations for scour effects. Designs and justifications of the robots are introduced. The robots are demonstrated for intended functions at bridge sites. The collected data are fed to machine, individualized, and domain-specific learning algorithms for element segmentation and defect classification. To guide defect inspection in real time, machine learning for instance segmentation of steel weld cracks, debonding, and porosities is demonstrated. These emerging technologies enable the implementation of objective decision-making processes in bridge asset management and the understanding of infrastructure resilience.

### **Bio:**

Dr. Chen is Professor and Abbett Distinguished Chair in Civil Engineering, Director of the Center for Intelligent Infrastructure, and Director of INSPIRE University Transportation Center at Missouri S&T. Between 1993 and 1996, Dr. Chen was a bridge consultant with Steinman Consulting Engineers, New York, NY. Since 1996 when joining Missouri S&T, Dr. Chen has authored or co-authored 491 products, including 234 journal publications, 20 keynote lectures, and six patents, in the areas of structural health monitoring (SHM), structural control, structural and robotic dynamics, computational and experimental mechanics, life-cycle assessment and deterioration mitigation of infrastructure, multi-hazards assessment and mitigation, transportation infrastructure preservation and resiliency.

His publications have been cited for 9,640 times, with an h-index of 55 and an i10-index of 196. He chaired the 9th International Conference on Structural Health Monitoring of Intelligent Infrastructure (SHMII-9), St. Louis, MO, on August 4-7, 2019. He received the 2025 American Society of Civil Engineers (ASCE) Charles Pankow Award for Innovation, the international 2019 SHM Person of the Year award, the 1998 National Science Foundation CAREER Award, the 2004 Academy of Civil Engineers Faculty Achievement Award, and the 2009, 2011, and 2013 Missouri S&T Faculty Research Awards. He is a Fellow of ASCE, the International Society for Structural Health Monitoring of Intelligent Infrastructure (ISHMII), Structural Engineering Institute (SEI), the International Society for Photonics and Optics (SPIE), and Taylor Geospatial Institute (TGI). He is an Intelligent Section Editor of the Sensors journal and Vice President of the U.S. Panel on Structural Control and Monitoring.



Monday, March 3, 2025 4:00 – 5:00 p.m.

1310 Yeh Student Center