COMPLEX SYSTEMS, COMPUTING, INFRASTRUCTURE & SENSORS FRONTIERS

Vedhus Hoskere

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Dr. Hoskere's research interests are in condition assessment systems to mitigate societal challenges posed by aging or sudden damage of civil infrastructure. His efforts emphasize developing solutions using machine learning, computer vision, structural dynamics, system identification, wireless sensor development, and engineering of software systems. His research experience spans the development of methods to harness modern technologies toward rapid post-disaster assessment and automated assessment of large-scale infrastructure. Dr. Hoskere has won multiple awards for his work including "best poster" at the Structural Health Monitoring of Intelligent Infrastructure (SHMII-9) and "best paper" at the ASCE EMI Structural Health Monitoring and Control competitions.

AUTONOMOUS CONDITION ASSESSMENT OF CIVIL INFRASTRUCTURE

Limitations in current inspection practices can amplify societal and economic costs, due to the difficulties in quickly obtaining reliable, actionable information. For example, after the 2017 Mexico City earthquake, hundreds of thousands of citizens were left waiting for up to twenty-one-days for an initial inspection before they could resume regular occupation of their homes, schools and businesses. As another example, in the United States, unscheduled closures of inland navigation infrastructure, like locks on dams, due to failure of uninspected components can cost up to $3 million per day. Dr. Hoskere's research seeks to develop autonomous condition assessment systems to help alleviate these problems.

Dr. Hoskere's research involves methods to automatically acquire images from the structures of interest using robots and process the large number of images using deep neural networks to obtain actionable information, enabling an inspector to quickly make high-level decisions. He also investigates methods for generation of synthetic models of damaged buildings using computer graphics and finite element simulations that can be used for end-to-end evaluation of autonomous assessment methods. Dr. Hoskere also investigates methods for system identification of structures using computer vision, including the use of UAVs for data acquisition.

RAPID POST DISASTER ASSESSMENTS: *UAVs for autonomous data acquisition*

Selected Publications

1. V. Hoskere, Y. Narazaki, T. A. Hoang, and B. F. Spencer, Jr., "MaDnet: Multi-task Semantic Segmentation of Multiple types of Structural Materials and Damage in Images of Civil Infrastructure," Journal of Civil Structural Health Monitoring, https://link.springer.com/article/10.1007/s13349-020-00409-0

2. Y. Narazaki, V. Hoskere, T. A. Hoang, Y. Fujino, A. Sakurai, and B. F. Spencer, Jr., "Vision-based Automated Bridge Component Recognition with High-level Scene Consistency," Computer-aided Civil and Infrastructure Engineering, https://doi.org/10.1111/mice.12505.

3. V. Hoskere, B. A. Eick, B. F. Spencer, Jr., M. D. Smith, and S. D. Foltz, "Deep Bayesian Neural Networks for Damage Quantification in Miter Gates of Navigation Locks," Structural Health Monitoring https://doi.org/10.1177/1475921719882086.

4. V. Hoskere, J. W. Park, H. Yoon, and B. F. Spencer, "Vision-Based Modal Survey of Civil Infrastructure Using Unmanned Aerial Vehicles," Journal of Structural Engineering (United States), vol. 145, no. 7, Jul. 2019, https://10.1061/(ASCE)ST.1943-541X.0002321.

5. B. F. Spencer Jr., V. Hoskere, and Y. Narazaki, "Advances in Computer Vision–based Civil Infrastructure Inspection and Monitoring," Engineering, vol. 5, no. 2, p. 199, April 2019, https://doi:10.1016/J.ENG.2018.11.030.

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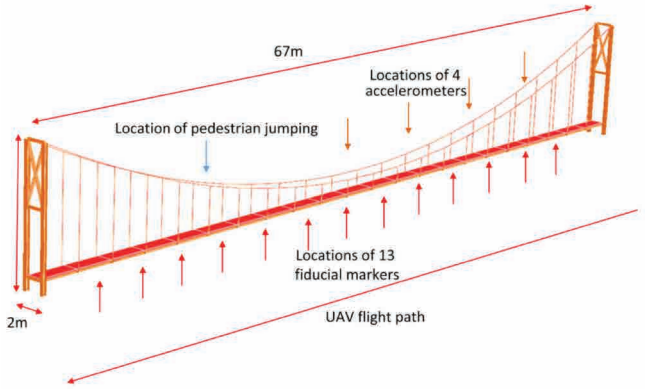
RAPID POST DISASTER ASSESSMENTS: *deep learning for autonomous data processing*

SYNTHETIC GRAPHICS MODELS FOR DEVELOPMENT AND VALIDATION OF END-TO-END INSPECTION METHOD: *(left) rendered images, (right) corresponding photographs of damaged structures*

UAV-BASED SYSTEM IDENTIFICATION OF CIVIL INFRASTRUCTURE: *UAV data acquisition*

UAV-BASED SYSTEM IDENTIFICATION OF CIVIL INFRASTRUCTURE: *field test schematic on pedestrian bridge*



UAV-BASED SYSTEM IDENTIFICATION OF CIVIL INFRASTRUCTURE: *identified mode shapes of vibrating bridge*