MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 19-403 (project 504) | December 2019

Improved Element-Level Bridge Inspection Criteria for Better Bridge Management and Preservation

the ISSUE

Collecting bridge inspection data is essential to bridge asset management and assuring that bridges receive timely maintenance so that highway maintenance investments can be directed most efficiently and bridges remain safe for users. This study proposed a holistic framework, from visual to in-depth inspection, to provide more reliable, consistent data for new element-level inspection and conditional assessment.

the RESEARCH

The reliability-based holistic framework was proposed to effectively collect reliable data and perform data fusion and information fusion of sensory data used for element-level inspection and conditional assessment.

A comprehensive literature review revealed that quality bridge element inspection data and the consistency of bridge element inspection were related to critical factors, including structural importance, material vulnerability, aging effects, and others. The study demonstrated that we could consider different condition rating by integrating these critical factors in the element-level inspection.

To overcome some challenges associate with various weather and environmental conditions, the use of an unmanned aerial (UAV) to enhance visual inspection dramatically impacted data collection by avoiding the use of subjective judgements and allowing researchers to reach otherwise inaccessible locations.

MOUNTAIN-PLAINS CONSORTIUM REGION 8

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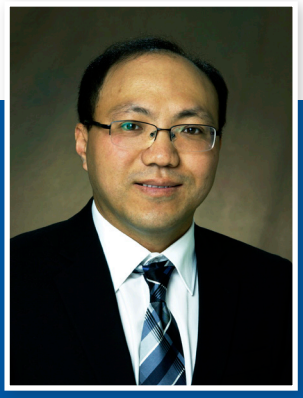

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Project Title

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the **RESEARCH** continued

In addition, three representative feature extraction techniques were explored to provide effective data fusion and information processing for in-depth/special/damage inspections. Results confirmed that these data-driven techniques exhibited high accuracy for distinguishing between undamaged and damaged elements, even when there was noise interference and under various operational conditions. Moreover, the data-driven classification methods in this study could effectively address the major factors of interest, including damage level, damage location, sensor location, and moving load.

the **FINDINGS**

The study confirmed that we could consider different condition ratings by integrating these critical factors in the element-level inspection because they provide more reliable data for bridge condition assessment. Future research could further quantify the weight of additional practices and datasets in bridge condition assessments. The use of UAVs was confirmed as an emerging technology for collecting reliable data in real time for bridge inspections, while minimizing the need for subjective judgements and enhancing the ability to inspect locations where traditionally manual visual inspection could be limited. Results confirmed that these data-driven techniques exhibited high accuracy in distinguishing between undamaged and damaged elements even when there was noise interference and under various operational conditions. Moreover, the data-driven classification methods in this study could effectively address the major factors of interest, including damage level, damage location, sensor location and moving load. The new model achieved the high accuracy in structural diagnostics.

the **IMPACT**

Timely information about bridge condition obtained during visual and in-depth inspection will be used for determining needed maintenance and repairs, for prioritizing rehabilitations and replacements, for allocating resources, and for evaluating and improving design for new bridges. The enhanced methods for data fusion and information extraction will be vital in that it not only impacts bridge funding appropriations, but also dramatically improve public safety.

For more information on this project, download the entire report at https://www.ugpti.org/resources/reports/details.php?id=986

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.