

Executive Summary, Research Readiness Level Assessment and Technology Transfer

Development and Implementation of a Moving Nondestructive Evaluation Platform for Bridge Deck Inspection

Research Objectives

Constructed a universal moving NDE platform that provided spatial positioning information for multiple NDE modalities.

Together with post-testing data fusion techniques, this platform allowed layering of data for presentation to bridge managers.

Research Benefits

This research enabled NDOT to optimize its maintenance and rehabilitation work on bridge decks. Significant resources can be saved as bridge deck condition assessments are improved and the right treatments are applied to the right bridges at the right time.

Because the proposed NDE platform was attachable to a standard receiver hitch, it was easily deployable on any standard pickup truck equipped to tow trailers.

It was also designed to accommodate multiple NDE techniques at different testing speeds.

Principal Investigators

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Background

Degradation in concrete bridge decks is typically manifested as rebar corrosion, concrete delamination, and surface cracks. Nondestructive evaluation and testing (NDE/NDT) technologies have been increasingly used in concrete bridge deck evaluation to identify, localize, and quantify deterioration in bridge decks. Each NDE method has its advantages and limitations on the type of defect that can be detected. Therefore, combining multiple NDE technologies is needed in order to give comprehensive and reliable information about the bridge deck condition. For effective application of multiple NDE tests, the research team needed to use automated positioning for each NDE to facilitate post-processing and data fusion of different NDE data.

Conclusion

The research team developed an NDE platform that will allow multiple NDE data collections either simultaneously or in sequence, with real time position information on bridge decks. The NDE platform consists of two main components: the data collection unit and the localization box. The data collection unit is made of a series of single board computers that were linked together to acquire data from many different channels. Any NDE technology with open data connection can be connected to the platform. The localization box incorporates localization devices including LiDAR, DGPS, and a camera as distance measurement instrument to accurately locate the signals captured by data collection unit. The moving NDE platform can be attached to hitch extension of a vehicle to provide a completely mobile solution.

Three Nebraska bridges were surveyed using four NDE technologies: Vertical Electrical Impedance (VEI), GPR, acoustic scanning system, and high definition imaging. Each bridge has different overlay type: no overlay, concrete overlay, and asphalt overlay. For each bridge deck, post-processed NDE data were analyzed, combined using two advance data fusion algorithms, and the final results are presented in 2D image maps.



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Final report is available at:
[NDOT Research Website](#)

NDOT Recommendations Based Off of Research Project

Since these technologies are still evolving, the Bridge Division Policy is not to own NDT equipment; therefore, it will be consulted out.

It is expected that NDOT pilot project will provide a mobile platform that will allow NDOT to more efficiently evaluate the condition of concrete bridge decks and achieve better maintenance and rehabilitation results.

The platform will be attachable to a standard receiver hitch and will be comprised of several features, including three positioning technologies such as, Vertical Electrical Impedance (VEI), GPR, acoustic scanning system, and high definition imaging and a networking unit that will accommodate various sensing modalities. NDOT is working closely with FHWA to implement/share the Department experience.

- *As provided by Fouad Jaber, Lead TAC Member*

Technology Transfer

Published Journal Papers

- Pashoutani, S., & Zhu, J. (2020). "Ground Penetrating Radar Data Processing for Concrete Bridge Deck Evaluation," Journal of Bridge Engineering, 25(7), 04020030.
- Sun, H.; Pashoutani, S.; Zhu, J. Nondestructive Evaluation of Concrete Bridge Decks with Automated Acoustic Scanning System and Ground Penetrating Radar. *Sensors* 2018, 18, 1955.

Webinars/Presentations

- Zhu, J. *Development and Implementation of a Moving Nondestructive Evaluation Platform for Bridge Deck Inspection*, Joint Tran- SET Webinar: Innovative Technology, Techniques, and Processes in Transportation Infrastructure Inspection, 9/26/2020.

Research Readiness Level (RRL) Assessment

RRL 3

Level 3: Development – Field Level

Research/Technology developed in an operational environment (real-world situation).

**This brief summarizes Project SPR-P1 (18) M075
“Development and Implementation of a Moving Nondestructive Evaluation Platform for Bridge Deck Inspection”
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