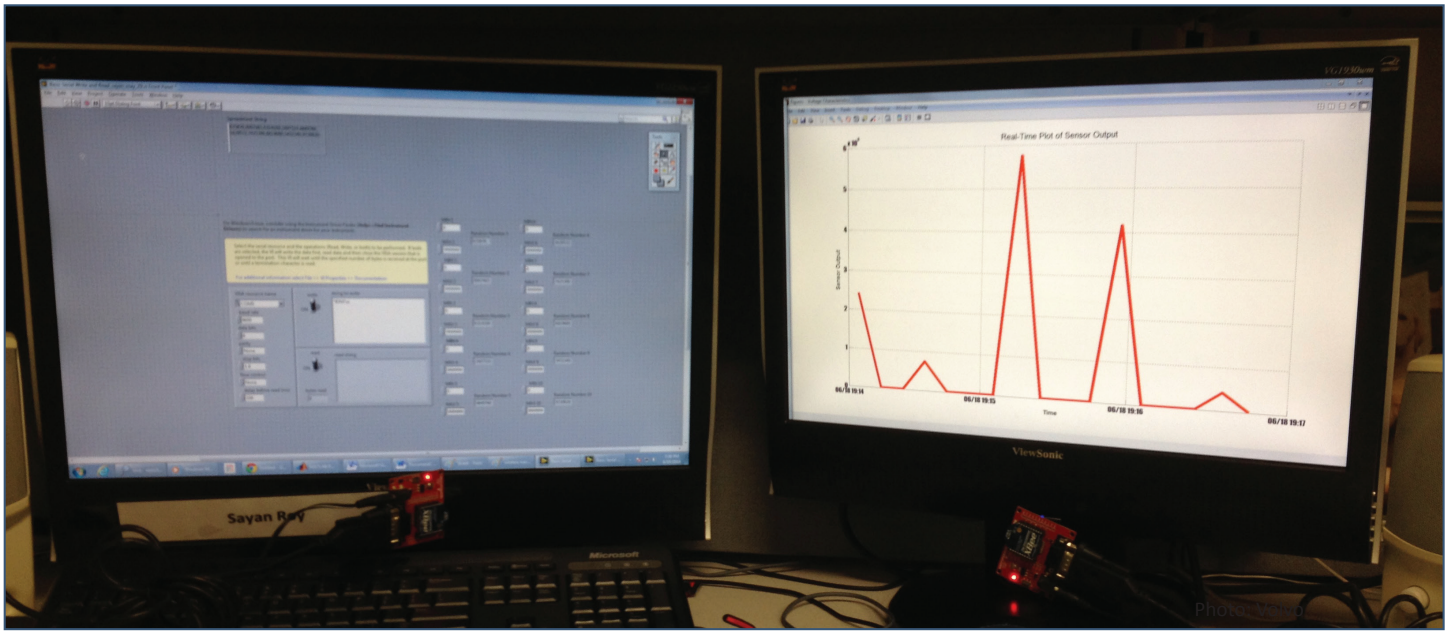
MOUNTAIN-PLAINS CONSORTIUM

PROJECT BRIEF | March 2015

An Integrated Real-Time Health Monitoring and Impact/ Collision Detection System for Bridges in Cold Remote Regions



the ISSUE

This report developed an integrated structural health monitoring and impact/collision detection system for bridges in remote cold regions, where in-person inspection may be difficult. The research report includes a model for impact event identification, laboratory experiment verification, and field testing.

the RESEARCH

The three-part research program examines the feasibility of building an integrated structural health monitoring and impact/collision detection system in remote cold regions. For the first phase, an algorithm is developed to identify the impact location and the impact magnitude using particle swarm optimization (PSO). The algorithm was tested to be effective in finding the impact location, the impact force magnitude, and the impact pulse frequencies. In the second phase, the developed algorithm was tested in a laboratory at North Dakota State University (NDSU). A plate with instrumented sensors is tested using impact hammers with noise considered. The developed algorithm is adopted successfully to locate the impact location, the impact magnitude, and the impact frequencies. Finally,

(cont.)

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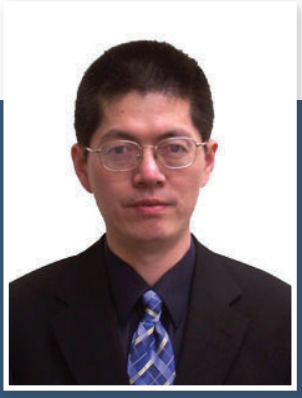

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Project Title

An Integrated Real-Time Health Monitoring and Impact/Collision Detection System for Bridges in Cold Remote Regions

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the RESEARCH (cont.)

implementation of the impact/collision system is combined with an innovative displacement based damage detection algorithm and used in a concrete bridge in Fargo, ND. Based on the measured data, a numerical model in ABAQUS was built using the so-called grillage method and validated through the field measurements. Based on the validated model and the simulated responses, the deformation-based damage detection method is tested and shown to find the damage location successfully and effectively.

the FINDINGS

1. Developed an integrated impact/collision detection and structural health monitoring system.
2. Suggested an innovative deformation-based damage detection method.
3. Verified both models in laboratory and in field.

the IMPACT

The developed system could serve as a "bridge doctor," which could automatically record impact/collision events that occur at each bridge and diagnose the health status of the bridge.

The system could be integrated with the existing bridge management information system and optimally allocate resources for effective bridge maintenance and repairs.

The system could also reduce the need for frequent visual inspection, reducing labor costs.

For more information on this project, download the entire report at http://www.ugpti.org/resources/reports/details.php?id=792

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7938 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.