Semi-Annual Progress Report

TIDC Transportation Infrastructure Durability Center AT THE UNIVERSITY OF MAINE

Project Number and Title: Thrust #1 Distributed Fiber Optic Sensing System for Bridge Monitoring
Research Area: Thrust #1
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Date: 03/29/2019

Overview:

The objective of this project is to develop a fiber optic sensing system using BOTDR (Brillouin Optical Time Domain Reflectometry) to monitor civil infrastructure systems such as highway bridges.

a. Integrate intelligent fully distributed fiber optic sensing cables to monitor highway bridges and send data to the asset owner.
b. Validate the sensing system on a bridge model.

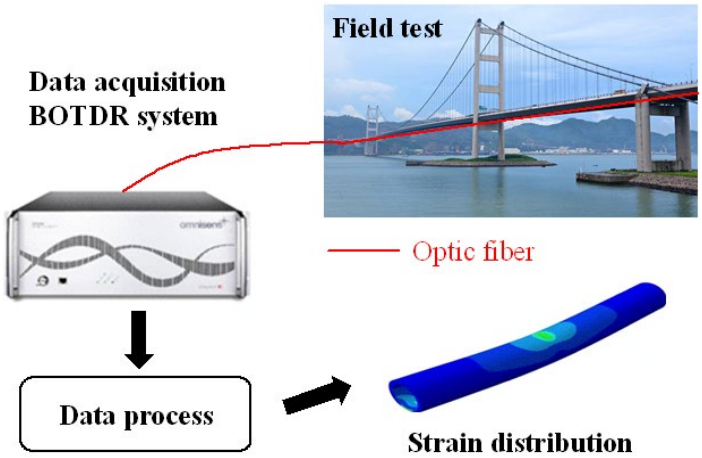

Figure 1: Overview of the proposed research

Benefits of activities

This project will enhance the transportation infrastructure durability as follows (list specific ways that the project will enhance durability):

a. Provide multiple-point sensing (distributed sensing) thus dramatically improving the sensitivity and reliability of the measurements.
b. Save time and money for the sensor installation training.

Accomplishment achieved

In the last few months, we have accomplished the following tasks:
1. Conducted a literature review on bridge strain monitoring cases using BOTDR technology;
2. Identified optical cables for the test;
3. Identified installation location of optical fiber cables on the bridge;
4. Placed the order for fiber cable samples and tools;
5. Contacted the City of Lowell (Ms. Christine Clancy, City Engineer) and identified the bridge for the field test;
6. Contacted Mass DOT (Mr. Alex Bardow, Director of Bridges and Structures);
7. Worked with UMass Lowell IT department to discuss the feasibility of connecting our sensing cables with the existed optical fiber cables for signal transmission.

Fiber cables with stainless steel packaging were selected to survive the field tests on a brdige. The schematic structure of this cable is shown in Fig. 2. The installation position was also identified, as shown in Fig. 3.

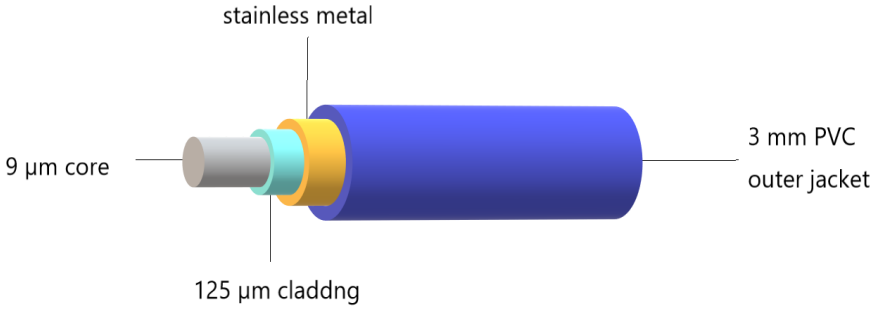

Figure 2: Schematic view of armored optical cable(FS20745 armored cable)

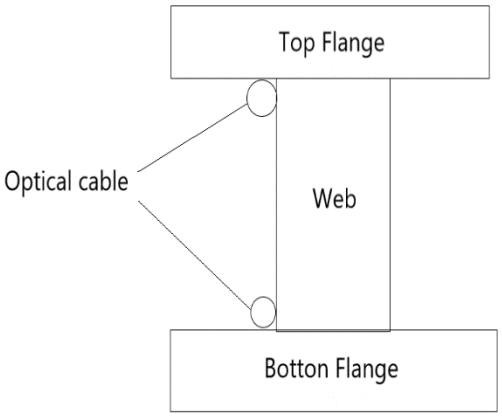

Figure 3: Installation position

Opportunities for training

A Ph.D. student, Hao Peng, is being trained to work on this project. He has spent a few months on literature review, prepared the slides, and assisted in report preparation. The goal is to improve his independent problem-solving skills. His oral and written presentation skills will improve at the end of this project.

Dissemination of research
This report.

Participants and Collaborators:
Organizations: City of Lowell (Ms. Christine Clancy) / MassDOT (Mr. Alex Bardow)

Changes:
None.

Changes in approach
N/A

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Planned Activities:

1. Order long fiber optic cables (e.g. 500m) and materials.
2. Modeling of the strain distribution on the bridge.
3. Conduct field test on a bridge (strain monitoring).
4. Signal processing; compare the experimental results with the theoretical analysis results.
5. Publications.