Fiber Optic Sensing Technology for Structural Health Monitoring of Bridges

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Introduction

The aging of civil infrastructure can have a big impact on the economy of a nation. For that reason, methods are needed to continuously monitor the aging process of the structure. This approach is known as structural health monitoring (SHM) and fiber cables provide a great sensing capability to achieve high sensitivity in a distributed way.

Figure 1. New Hampshire bridge where sensing textile was installed

Fiber Optic Principle

Distributed sensing techniques are implemented using fiber cables. There are multiples techniques that can be used to interrogate the fiber. In this case, the field test data was collected using Brillouin Optical Time Domain reflectometry (BOTDR). This technique measures the backscatter Brillouin signal to determine either the strain or temperature that is affecting the structure.
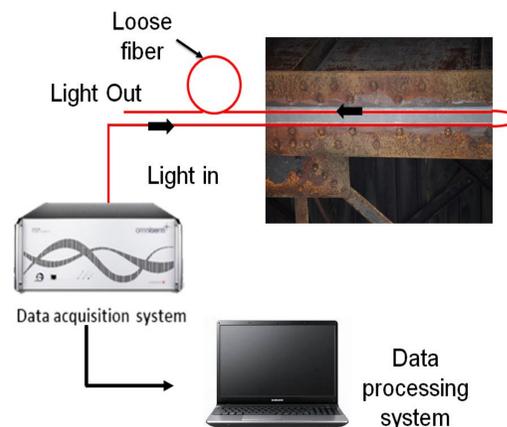

Figure 2. Distributed Fiber Optic sensing system

Field test results

The fiber sensing textile was installed on a railway bridge located in New Hampshire to measure the effects of a train passing by the bridge. Data were collected before the event and during the event. When compared, we see an increase in the total strain in the structure. This response is due to the increment of load in the bridge which creates stress at the bottom of the bridge.

If the bridge is monitored regularly, a change on the signal behavior will indicate that the bridge has either a structural problem or it is in the process of degrading.
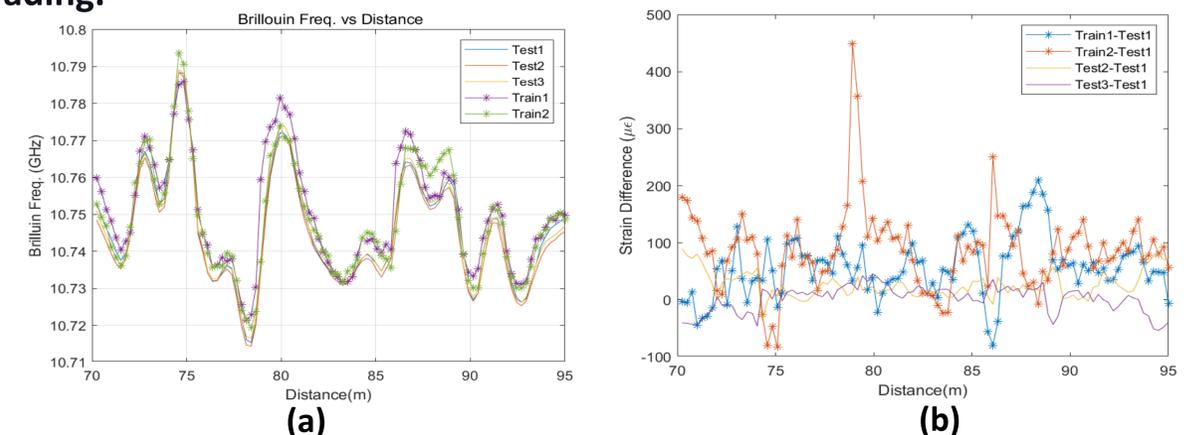

Figure 3. Field test result. Fig. (a) shows the frequency shift and Fig. (b) the strain difference

Conclusion

The proposed sensing textile demonstrated its capabilities to monitor strain changes on infrastructure. Additionally, its ability for long-range monitoring makes this technology attractive in different industry areas such as oil and gas and railway. Further investigation on the performance during different weather condition is currently in progress.

Acknowledgments