Dynamic Remote Sensing and Optical Distributed Sensing Applications for Bridge Health Monitoring

Presented by

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Abstract

In this seminar talk, two different bridge health monitoring techniques are introduced with field applications on two real bridges in New England. The first technique is the dynamic remote sensing of bridges using a portable laser Doppler vibrometry (LDV) system. The mid-span dynamic displacement of a steel railway bridge (Salmon Falls River Bridge, Rollinsford, NH) was measured by a short wavelength infrared (SWIR) LDV system under train loading (forced vibration) and in free vibration. The forced vibration of the bridge was induced by the Amtrak Downeaster. From the dynamic displacement of forced vibration, the train speed was estimated. The fundamental modal mass, modal damping and modal stiffness of the bridge were also calculated by using a bounding approach in which a lower bound value and an upper bound value of mass, damping, and stiffness were calculated. From our approach, the range between the lower bound value and the upper bound value was only 4.485% of the lower bound value, demonstrating the satisfactory performance of this dynamic remote sensing technique.

The second technique is the optical distributed sensing of bridges using sensing textiles. A sensing textile is comprised of an optical fiber and a fabric backing layer. The pattern of optical fibers in a sensing textile is designed based on the objective of bridge health monitoring and the behavior of a bridge. Optical signals were demodulated by using Brillouin optical time domain analysis (BOTDA) to extract distributed strain data on the bridge, after temperature compensation. A structural model was developed for curve fitting to extract structural property of the bridge. Installation procedure of sensing textiles and signal processing was demonstrated by a FRP composite bridge (Hampden Bridge, Hampden, ME) manufactured and constructed in 2020. From our data analysis, changes in structural property of the bridge was found and can be used for long-term bridge health monitoring.


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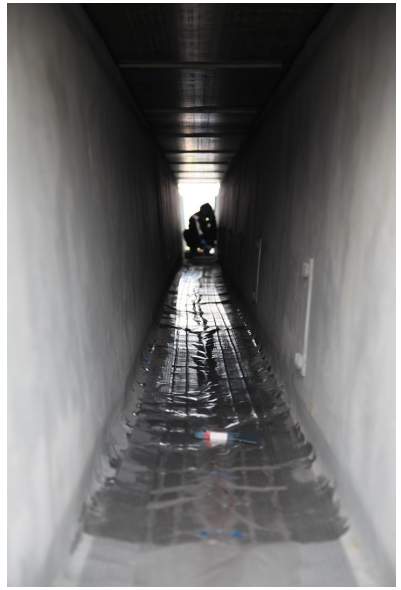


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