Project 1.5: Distributed Sensing Textile for Bridge Monitoring

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Abstract

In recent years, distributed structural health monitoring has emerged as a prominent research area. Optical fiber sensors have garnered significant attention due to their distinct advantages, including high sensitivity, enhanced spatial resolution, and compact sensor size. However, the installation process and reliability of these fibers have posed significant challenges, constituting the primary drawbacks of this technology. This paper introduces a novel approach to address these limitations within fiber sensing systems, presenting a fiber optic sensing textile and an innovative installation method within bridge girders.

The proposed sensing textile was employed to monitor strain distribution within the Grist Mill Bridge, situated in Maine, utilizing Brillouin Optical Time Domain Analysis (BOTDA). To enhance installation efficiency within the confined bridge girders, a modified slider was developed. Through four years of annual data monitoring, we have acquired stress distribution data for the bridge. By comparing the data variations each year, we can ascertain that the distributed fiber optic stress monitoring system has successfully withstood the environmental conditions, weather fluctuations, and temperature changes prevalent in the New England region over this period. This demonstrates the system's commendable stability and durability. A detailed analysis of the data reveals a consistent stress distribution pattern in the bridge under unloaded conditions throughout the four-year period, with minimal deviations from the expected values. This consistent behavior attests to the structural integrity of the bridge, with no significant issues evident.

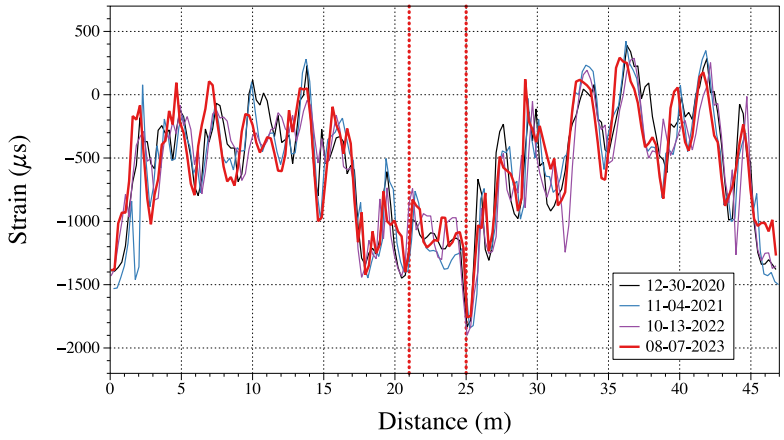

Figure 1 Long-term monitoring results on Grist Mill Bridge.

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