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Robust Wireless Skin Sensor Networks for Long-Term Fatigue Crack Monitoring of Bridges

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Abstract

Fatigue-induced cracks that develop in steel bridges are one of the primary mechanisms of structural degradation and are of concern to Departments of Transportation. A significant number of steel bridges in the U.S. are rated in poor condition and are vulnerable to fatigue damage. Despite various crack monitoring methods that have been proposed in the fields of structural health monitoring (SHM) and non-destructive evaluation (NDE), automated fatigue crack detection and monitoring using commercial sensing technology remains challenging due to the complex structural layout and the variability of crack initiation and propagation. Our research team has recently proposed and developed an innovative robust wireless skin sensor network based on a new generation of a soft elastomeric capacitors (SECs). SECs are inexpensive, easy to fabricate, and their ultra-compliance greatly facilitates their implementation on large and complex geometries. While they function as strain gauges, their unique large-surface coverage capability provides the potential for crack discovery. The overarching objective of this pooled fund project is to enable large-scale deployments of the SEC-based technology through developing and testing autonomous, continuous, accurate, and long-term crack monitoring capabilities. In this talk, we will describe the technology and review the progress in its development, characterization, and field demonstration. We will also discuss opportunities and challenges toward broad field implementations.