Smart Skin for Fatigue Crack Detection

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Fatigue cracks on steel components may have strong consequences on the structure's serviceability and strength. Their detection and localization is a difficult task. Existing technologies enabling structural health monitoring have a complex link signal-to-damage or have economic barriers impeding large-scale deployment. A solution is to develop sensing methods that are inexpensive, scalable, with signals that can directly relate to damage. The authors have recently proposed a smart sensing skin for structural health monitoring applications to mesosystems. The sensor is a thin film soft elastomeric capacitor (SEC) that transduces strain into a measurable change in capacitance. Arranged in a network configuration, the SEC would have the capacity to detect and localize damage by detecting local deformation over a global surface, analogous to biological skin. In this presentation, we discuss the latest test results demonstrating the performance of the SEC at detecting, localizing, and quantifying fatigue cracks. In particular, results show that the SEC is capable of detecting high-cycle fatigue cracks. The quantification of damage is conducted by fusing sensor data into a crack growth indicator, constructed through the analysis of peaks in the power spectra density domain.