Computer Vision And Augmented Reality For Human-Centered Fatigue Crack Inspection Of Steel Bridges

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Human visual inspection is currently the de facto approach for bridge maintenance as bridge inspections strongly rely on inspectors' expertise and experience. However, current inspection practice lacks a reliable mechanism to detect small defects of steel bridges such as fatigue cracks as well as a human-centered, efficient and cost-effective methodology to document and track these defects. This research aims at integrating modern computer vision and augmented reality (AR) technologies to empower bridge inspectors to perform robust fatigue crack detection, characterization, tracking, and documentation in the field. First, a novel fatigue crack detection method is proposed based on tracking local distance change through computer vision to overcome strong parallax effects in 3D video scenes commonly seem in steel bridges. Second, a unique interactive AR software package is developed for the Microsoft HoloLens 2 to convert the crack detection result into holographic images overlaid on top of the real-world bridge to facilitate human-centered inspection. Third, a framework is created through an online database to enable seamless integration of the computer vision and AR components for near real-time fatigue crack inspection. The developed methodology is demonstrated using realistic laboratory setups including a compact, C(T), specimen with a 2D scene for in-plane cracks and a large-scale bridge girder specimen with a 3D scene for distortion-induced fatigue cracks.