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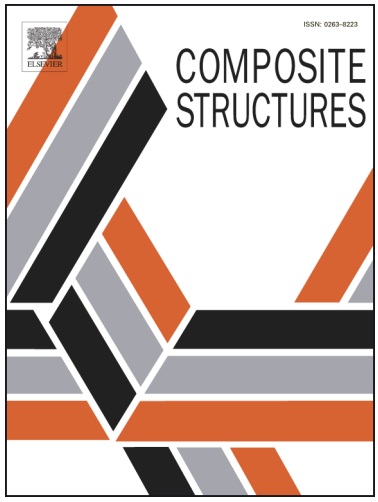

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ACCEPTED MANUSCRIPT

INTEGRATION OF CARBON NANOTUBE SENSING SKINS AND CARBON FIBER COMPOSITES FOR MONITORING AND STRUCTURAL REPAIR OF FATIGUE CRACKED METAL STRUCTURES

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ABSTRACT

Advanced composite materials have been investigated for repair of fatigue-damaged metal structures, but one of the challenges is the repair often covers-up underlying damage, preventing visual inspection. A novel approach where a carbon nanotube-based sensing layer integrated in a steel/composite adhesive bond has been investigated as an approach for repair while adding capability to detect the adhesive bond integrity and monitor propagation of cracks in the underlying substrate. The sensing layer, composed of a random mat of aramid fibers coated with carbon nanotubes, offers tremendous application flexibility for integration of sensing capabilities in structures. Experiments examining fatigue crack propagation in structural steel with a composite repair and integrated bondline sensing increased the fatigue life by 380% to over 500%, depending on configuration. The sensing layer was able to monitor deformation and crack propagation in real-time and shows potential for use in periodic inspection-based monitoring of cracks using electrical property changes.

Keywords: Fatigue fracture, composite repair, structural rehabilitation, carbon nanotubes, crack monitoring, structural health monitoring.

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