An Image-Based Algorithm for the Automatic Detection of Loosened Bolts †

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Abstract: The bolted joint has been widely used to connect load-bearing elements in aerospace, civil, and mechanical engineering systems. During its service life, particularly under external dynamical loads, a bolted joint may undergo self-loosening. Bolt looseness causes a reduction in its load-bearing capacity and eventually leads to the failure of a bolted joint. This paper presents an automated image-based algorithm combining the Faster R-CNN model with image processing for the quick detection of loosened bolts in a structural connection. The algorithm is validated using a lab-scale bolted joint model for which various bolt-loosening events are simulated. The imagery data of the joint is captured and passed through the algorithm for bolt looseness detection. The obtained results show that the loosened bolts in the joint were well-detected and that their loosening degrees were precisely quantified; therefore, the image-based algorithm is promising for real-time structural health monitoring of realistic bolted joints.

Keywords: image-based algorithm; Faster R-CNN; image processing; structural health monitoring; bolted connection; bolt looseness detection

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