No-reference image quality assessment for automated tunnel inspection

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ABSTRACT

The Mobile Tunnel Scanning System (MTSS) captures images of concrete tunnel linings at high speeds for automated crack detection; however, such high-speed operation often induces motion blur that degrades image quality and undermines the reliability of convolutional neural network (CNN)-based crack detection. In this study, we systematically evaluate four established no-reference image quality assessment (NR-IQA) metrics—BRISQUE, NIQE, PIQE, and CPBD—using real images acquired by an MTSS to investigate how effectively each metric quantifies motion-blur-induced degradation. A comparative analysis of these metrics' sensitivity to motion blur reveals distinct differences in their responses to motion-induced image degradation. The findings highlight the relative strengths and limitations of each metric in detecting blur artifacts and provide guidance for selecting appropriate image quality measures to ensure reliable CNN-based crack detection under high-speed tunnel inspection conditions.

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