Automated Crack Detection Method Based on Deep Learning and 3D Reconstruction for Concrete Bridges

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Abstract

Automated image-based bridge crack detection, as a promising technique, can be used to overcome the limitations of human visual inspection. However, results from current image-based methods are generally localized and lack 3D geometric information, which makes it difficult for structural assessment. To solve this issue, a crack detection method that combines deep learning and 3D reconstruction is proposed in this paper. Firstly, a 2D feature-based approach is developed to extract keyframes from the video adaptively. Secondly, a segmentation network is implemented to conduct pixel-level crack segmentation. Finally, image-based 3D reconstruction and crack mapping are used to create the 3D structure model with crack semantics. A field experiment is also carried out on an in-service concrete bridge for validation and discussion of the proposed method. The 3D model created by the proposed method can significantly improve the crack inspection of concrete bridges.

Keywords: bridge crack inspection; crack detection; deep learning; 3D reconstruction.

1 Introduction

As one of the most important transport infrastructures, bridges are vital to the proper functioning of modern society. To ensure the safety of bridges, regular visual inspections are required, of which surface cracks are one of the indispensable inspected items. Currently, the inspection of surface cracks in bridges is mainly conducted manually, which consumes human resources and has the limitations of being time-consuming and dangerous [1].

To improve the crack inspection process, computer vision-based methods for automated bridge crack detection have been widely studied in the last two decades. Traditional image-based crack detection is mainly based on image processing techniques (IPT) [2,3], but these methods are difficult to distinguish the crack-like interference (e.g., Shadow) in complex scenes. Recently, deep learning is regarded as a promising technique and has been widely used in crack detection [4-6]. Deep learning-based methods greatly improve the identification capability by learning crack features from the dataset and show great potential for

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