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Crack Detection Method for Civil Infrastructures using Unmanned Aerial Vehicles and Feature Pyramid Networks

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ABSTRACT

Crack detection is one of the key contents of civil infrastructural inspection. The existing detection methods have many drawbacks, and there is an urgent need for a non-destructive and highly automated method to meet the actual needs of crack detection. In this paper, a new crack detection method for civil infrastructure using unmanned aerial vehicles (UAVs) and feature pyramid networks (FPNs) is proposed. First, an improved calibration method is used to calibrate the image scale factor of the UAV gimbal camera under different measurement distances and angles. A nonlinear distribution state of the full-field scale in the image coordinate system is obtained, and an accurate mathematical model is established. Next, an FPN-based segmentation method is proposed for realizing the accurate segmentation of different-sized cracks in complex backgrounds. At the same time, a dataset containing 1500 images of different-sized cracks is constructed and used to train deep-learning models. By obtaining the accurate contour of the crack area in the image, and combined with the image scale field obtained by the calibration calculation, crack localization and quantitative measurement of the inaccessible structure cracking part can be completed. A field test investigation of crack detection of a real building using UAV is carried out for illustration and validation of the proposed method.

Keywords: Crack detection; Quantitative measurement; Image scale field; Unmanned aerial vehicle; Feature pyramid network

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