

Robust pixel-level crack detection for glass curtain wall using synthetic images and EdgeEnhanced-DNet

Wen-Bo Hu¹⁾, *Zheng-Wei Chen²⁾ and Yi-Qing Ni³⁾

1), 2), 3) Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hong Kong 999077, China;

National Rail Transit Electrification and Automation Engineering Technology Research Center (Hong Kong Branch), Hong Kong 999077, China

2) zhengwei.chen@polyu.edu.hk

ABSTRACT

Generic deep learning models often have difficulty in detecting cracks on glass curtain walls, and the insufficient amount of available data is largely attributed to this. To address this issue, an image synthesis method is developed that aims to generate both diverse and high-resolution synthesized images of cracks on glass curtain walls. Specifically, a cycle-consistent generative adversarial network is employed to integrate the background image of the glass curtain wall and the crack mask for generating crack images which are indistinguishable from the real images, aiming to increase the richness and diversity of the training data. In addition, an improved encoder-decoder architecture is proposed using these synthesized crack images, namely EdgeEnhanced-DNet. Unlike the original DeepLabv3+, a novel boundary loss function is used in EdgeEnhanced-DNet for increasing the attention of boundary information in network training, and the single-resolution feature maps output from the original backbone layer are increased to three for segmenting the cracks of narrow and feature-rich boundaries from glass curtain walls. The results show that the crack detection performance of EdgeEnhanced-DNet, which has been fully trained with a synthetic dataset of virtual to real ratios, is much better than that of no virtual data, with an MIoU improvement of over 10%. In addition, synthetic data can greatly enlarge the range, type, and number of discriminative crack features compared with data augmentation based on limited real data, thus enhancing the performance of deep learning models for uncertain inspection data.

¹⁾ Postdoctoral Fellow

²⁾ Research Assistant Professor

³⁾ Professor