

CHAPTER

4

COMPUTER VISION FOR STRUCTURE CRACK DETECTION

Herman Wahid and Irfan Rusyaidi Zulhilmi

4.1 INTRODUCTION

To keep any infrastructure safe, it is crucial to detect early structural anomalies. One of the most common anomalies is cracks, whether in buildings or bridges, which can be an early indicator of a potential hazard, for e.g. as shown in Figure 4.1. The statistical characteristics of cracks in building structures are important for assessing their condition (Lyasheva et al., 2019). It is essential to develop a system or device that can identify anomalies quickly and accurately. By combining both Artificial Intelligence (AI) and computer vision, a strong solution can be created to automate and enhance the process of crack detection, offering a proactive approach to monitoring structural condition.

This work mainly focuses on the capabilities of AI and computer vision to develop an efficient system for crack detection. Traditional crack inspection methods often rely on manual efforts, which can lead to time-consuming processes, human error, and limited coverage. The results of manual inspections do not always conform to the standards set by regulating bodies, as the nature of detections can vary based on the skill level of different operators (Mandal et al., 2018). This work aims to improve the process by offering cutting-edge technologies that can automate real-time and accurate crack detection. The proposed system

can continuously monitor important structures, detect even the slightest changes in the structure for cracking, and send alerts to the control centre. Therefore, it will significantly enhance the safety of the structure (Mirbod & Shoar, 2023). This demonstrates how using the system can help ensure the safety of the structure.



Figure 4.1 Example of crack structure

The focus of this project will be the application of image processing techniques, machine learning, and deep learning algorithms. Convolutional Neural Networks (CNN) will play a vital role in training the system to recognise patterns and various types of cracks. By utilising labelled datasets containing images of both non-cracked and cracked structures, CNN has become a powerful and efficient tool for computer vision tasks, such as image recognition, semantic segmentation, and object detection (Liu et al., 2022). The AI model will be able to learn to differentiate between normal and potentially hazardous structural defects.

4.2 VARIOUS CRACK DETECTION METHODS

Inspection and maintenance play an important role in ensuring the safety and longevity of structures. Timely and accurate crack detection can provide indicators of structural deterioration and potential safety hazards. The Computer Vision (CV) method can also offer better accuracy in detecting cracks. Hence, the implementation of the proposed project can help society ensure the safety of its infrastructure.

Moreover, the use of crack detection through CV offers many benefits compared to traditional methods. It can detect various types of cracks and provide high accuracy in identifying the type of crack. CV enables machines to learn from the features of digital images and videos, providing a better understanding of features and patterns through visual information (Ali et al., 2022). The lack of AI implementation, especially in the engineering field, is a major loss, considering how powerful AI can be in reducing the burden of human labour.

In general, there are five main architectural approaches for crack detection using image processing techniques, as illustrated in Figure 4.2. First, images of the structure related to the crack are captured using a camera. Next, the images are pre-processed and segmented to improve the efficiency of the image processing process. Third, techniques are employed to process the detected image samples. Fourth, the crack structure is identified in the processed image. Lastly, the crack features are extracted (Mohan & Poobal, 2018).

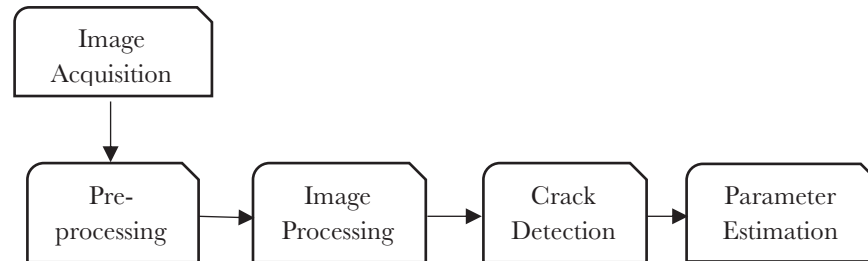


Figure 4.2 Architecture of image processing-based for crack detection