



Computer Vision Techniques for Bridge Bearing Condition Assessment using Visual Inspection Photographs

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Summary

This paper is proposed a computer vision technique for measuring the static displacement of bridges with changes in temperature using a general photograph, which is stored in the database of the bridge management system (BMS) for visual inspection. Also, the proposed methodology is developed using open source computer vision (OpenCV) language program and validated both in the laboratory using a bearing model and on an actual bridge. The proposed numerical procedure shows that the non-target image-based technique using Gaussian high-pass filters in the frequency domain, projective linear transformation (PIT) and digital image correlation (DIC) algorithm can extract the displacement of a bearing. It is concluded that this technique is able to obtain the bridge bearing condition assessment.

Keywords: Bearing inspection; Computer vision technique; Smartphone; OpenCV; Seohae cable-stayed bridge

1. Introduction

According to the bridge management system (BMS) used by the Korea Highway Corporation, 34% of the cost of bridge maintenance is used for the replacement of the bridge bearings and expansion joints. In many cases only visual inspection by humans can provide the required information for the bearings and expansion joints of bridges, in terms of the current material condition or the extent of needed repair. Thus, repaired bridges develop defects after operating a while, and the maintenance costs are too high.

Most bridges in Korea have deteriorated over the years, and they require frequent inspection. Visual inspection is the current means of inspection, which involves manual measurements. This is a tedious and time-consuming process; moreover, inspectors with different credentials and training may render different conclusions of similar conditions. Inspection techniques using instruments, such as non-destructive testing (NDT), provide inspection of only small bridge sections at a time. Thus, the inspection of an entire bridge using such techniques may be impractical and expensive.

Computer image processing is a form of signal processing in which the input is an image, such as a photograph or video frame, and the output may be either an image or a set of characteristics or parameters related to the image. In most image processing techniques, the image is treated as a two-dimensional signal, and standard signal processing techniques are applied to it. With the development of fast computers and signal processors in the 2000s, it became possible to use image processing techniques for bridge engineering applications, including the measurement of civil engineering structures. This is even true with the rapid development of digital cameras in the last few years.

Olaszek (1999) developed a method that integrated the photogrammetric principle with the computer vision technique to investigate the dynamic characteristics of bridges. Patsias and