A novel portable vision-based bridge weigh in motion method

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Abstract

Accurate vehicle load information is critical for bridge maintenance. On the one hand, traditional weigh-in-motion (WIM) and bridge weigh-in-motion (BWIM) have certain limitations due to their high cost and complicated installation. On the other hand, targetless contactless bridge weigh-in-motion(CBWIM) is easy to install, but due to the lack of marker points and low image quality, resulting in poor recognition accuracy, it cannot be widely promoted. In this paper, we propose a novel portable vision-based bridge weigh-in-motion method(PBWIM). First, a high-precision image encoding system and illumination-invariant infrared target device were developed, which were installed at the bottom of the beam. Then, the target tracking algorithm based on improved geometric matching automatically identifies the target point image and calculates the actual displacement to obtain the deflection time-history curve. Finally, the accurate vehicle weight is calculated by solving the Tikhonov regularized error equation. After field tests, the results show that the method proposed in this paper has a greater efficiency than the CBWIM algorithm, and can basically achieve the recognition accuracy of the traditional BWIM, and the cost is low, which has a wide range of application and promotion significance.

Keywords: bridge weigh-in-motion; object detection; vehicle load monitoring; computer vision; displacement monitoring.

1 Introduction

The accurate identification of vehicle loads plays an important role in the maintenance and operation of bridges. Traditional WIM methods require sensors to be installed under the road surface, which requires disruption to traffic and is prone to damage. The traditional BWIM method obtains information such as the wheelbase and speed of the vehicle on the bridge deck through the FAD sensor, and then combines the WS sensor to calculate the weight information of the vehicle during driving, but this method requires the installation of many sensors and special data processing equipment , higher cost. In recent years, with the development of computer vision, vision-based monitoring methods have received extensive attention from scholars.

At present, a considerable number of bridges are equipped with video monitoring systems. At the same time, with the development of deep learning technology, the detection and tracking of vehicles

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