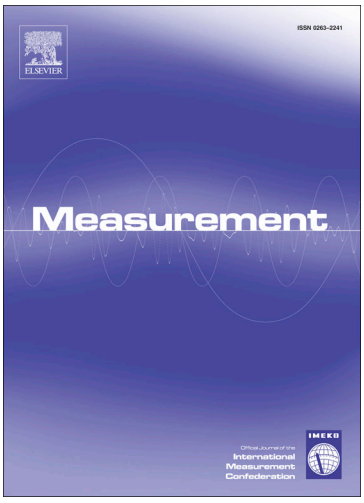

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Measurement of the Real-time Deflection of Cable-Stayed Bridge Based on Cable Tension Variations

Yonghui Huang[1], Yang Wang[1], Jiyang Fu[1*], Airong Liu[1], Wei Gao[2]

[1]Guangzhou University-Tamkang University Joint Research Center for Engineering Structure Disaster Prevention and Control, Guangzhou University, Guangzhou 510006, China

[2]Centre for Infrastructure Engineering and Safety (CIES), School of Civil and Environmental Engineering, The University of New South Wales, Sydney, NSW 2052, Australia

Abstract: Measuring the real-time deflection of a bridge is vital to understand its behavior and performance. Although automated structural health monitoring systems have been established for many long span bridges, continuously measuring the real-time deflection of a bridge is still cumbersome. According to the mechanical and structural features of cable-stayed bridge, a novel method, for measuring the real-time deflection of cable-stayed bridge based on variations of cable tension, is freshly proposed. The relationship between the variation of cable tension and the deflection of the anchor point between the cable and girder is formulized building upon the geometric relationship of the deformation. Then, the real-time frequency of the cable is calculated from the measured acceleration signals using a time-frequency analysis method referred to as the Hilbert-Huang Transform. Consequently, the real-time cable tension is computed and the deflections of the anchor points of the girder are obtained. In the practical structural health monitoring of a cable stayed-bridge that realistically monitors the tension in many cables, measurements of the kinetic deflection curve of the girder can be achieved without requiring additional equipment. A numerical example is implemented to verify the accuracy of the proposed method. In addition, through a real engineering application of the He-dong Bridge, the feasibility and effectiveness of the proposed method are demonstrated by a comparison with global positioning system (GPS) observation results. The developed method can provide an alternative cost-effective option for the real-time deflection measurement of cable-stayed bridges.

Keywords: Real-time deflection; Structural health monitoring; Cable-stayed bridge;