Identification of Bridge Surface Roughness Profile Using Drive-by Technique

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Abstract

As the surface roughness of a bridge has significant influence on the interaction between a moving vehicle and the bridge, it is one of the hurdles for the use of drive-by technique in the assessment of bridges. The proper identification of surface roughness of a bridge will be most useful to the minimization of associated uncertainties and improvement of accuracy of numerical simulation. This paper presents a novel method for estimation of the bridge surface roughness profile from the responses extracted from an instrumented vehicle based on vehicle-bridge interaction. By letting the vehicle run along the bridge with different added masses, an estimation of the roughness profile can be obtained. The feasibility and effectiveness of this method are studied by finite element simulation.

Keywords: drive-by technique; finite element method; roughness profile; vehicle-bridge interaction.

1 Introduction

Bridges are a core component of the transportation infrastructure system. Building bridges costs a large amount of labour and resources. Yet proper monitoring, maintenance and repair are essential to ensure safe and long service. Monitoring the bridge properties is therefore a basic and often encountered task. It provides valuable information for estimating the status of new bridges, based on which the design codes can be improved. It gives guidance for regular maintenance and renovation. It also helps to assess the serviceability such as remaining service life of old bridges. Therefore, identifying the dynamic parameters of bridges has always been a primary objective of structural health monitoring and damage detection, which are hot topics in bridge engineering. Various methods have been proposed for identifying different bridge parameters. One of the low cost and convenient methods is the drive-by parameter identification approach.

The bridge and the vehicle running on it are usually treated as a coupled vibration system in various types of identification problems. The properties of a moving vehicle can be identified from the bridge vibration data [1]. From the vibration data measured from an instrumented vehicle moving on a bridge, the bridge dynamic parameters can also be derived [2].

Using vehicles instrumented with sensors to detect bridge parameters is an indirect method that is both economical and convenient, and the disruption to normal traffic on bridge can be minimized as compared to other methods [3]. The basis of the method is that the vehicle vibration information contains the bridge vibration information and hence the bridge dynamic

https://doi.org/10.2749/222137817822208834
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