Incorporating Noise Effect in Damage Detection With a Curvature Based Method

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Abstract

Damage detection is essential for ensuing safety of bridges, and many damage detection methods have been developed in the past few years, which utilizes static or dynamic responses. In this paper, a curvature-based method is proposed for damage detection. In order to verify its reliability and efficacy, laboratory experiment is conducted on a beam specimen, and the measured displacement is used to identify damage with the proposed method. Damage location and severity were both identified. Taking into account measurement noise, two techniques are proposed to reduce effect of measurement noise. The first one uses averaged multiple measurement, and the other one chooses reasonable interval for curvature calculation. They are both verified with the measurements from the laboratory test.

Keywords: Curvature-based; damage detection; Maxwell-Betti reciprocity theorem; measurement noise; curvature change

1. Introduction

To ensure sustainable economic growth and well-being of the society, safety and serviceability of civil infrastructures, especially bridges, is an important issue. Factors such as construction defects, structural deterioration, material degradation and aging, harsh environmental conditions, changing and increasing of loading, as well as extreme events such as natural disasters may contribute to the failure of an infrastructure system to various degrees, from non-optimal performance to a total breakdown[1].

Visual inspection is mainly adopted for evaluating bridge health condition in engineering practice, but it is subjective and suffers from limitation of human visibility. Non-destructive techniques such as acoustic emission method, magnetic method, radiography method are attracting more attention recently. These techniques require that prior knowledge about damage vicinity is known, and that the inspecting portion is readily accessible[2]. Subjected to these

https://doi.org/10.2749/222137816819258906