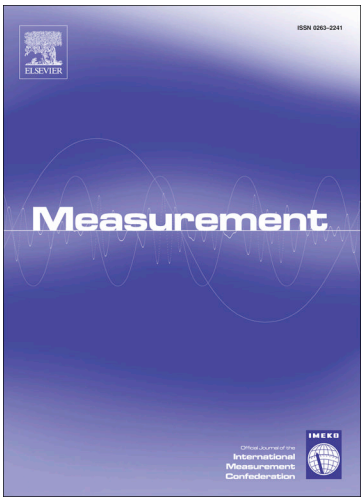

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Non-model-based multiple damage identification of beams by a continuously scanning laser Doppler vibrometer system

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Abstract

An effective non-model-based multiple damage identification method for beams by using a continuously scanning laser Doppler vibrometer (CSLDV) system is presented. Velocity response of a beam along a scan line under sinusoidal excitation is measured by the CSLDV system and a spatially dense operating deflection shape (ODS) of the beam along the scan line is obtained by the demodulation method from velocity response. An ODS of an associated undamaged beam is obtained by using a polynomial with a proper order to fit the ODS from the demodulation method. The curvature of an ODS (CODS) is used to identify abnormality induced by multiple damage. A curvature damage index (CDI) using differences between CODSs associated with ODSs that are obtained by the demodulation method and the polynomial fit is proposed to identify multiple damage. A normalized average CDI obtained by averaging CDIs at different excitation frequencies is defined to further assist multiple damage identification. Experiments on three beams with three damage on each beam in the form of three small cuts are conducted. Widths and depths of the three damage are varied from 3 mm to 9 mm with an increment of 3 mm and from 5% thickness reduction to 15% with an increment of 5%, respectively, and their effects on ODSs, CODSs, and CDIs are investigated. Five frequencies obtained by rounding the first through fifth natural frequencies of the beams and one arbitrarily selected

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