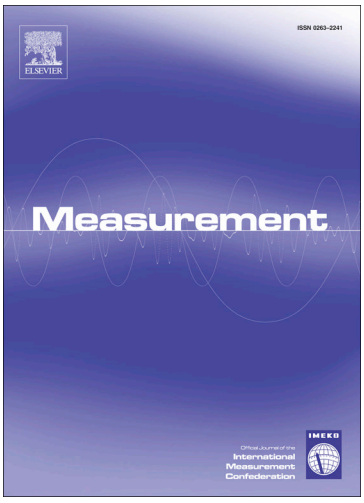

Damage Localization of Beam Structures using Mode Shape Extracted from Moving Vehicle Response

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Damage Localization of Beam Structures using Mode Shape Extracted from Moving Vehicle Response

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Abstract: Mode shape curvature change has been regarded as a promising damage localization index (DLI). However, its application is limited by the requirement for high spatial resolution and reference mode shapes, and the central difference method induced low anti-noise ability. This paper aims to develop a new damage localization method by using the mode shapes extracted from moving vehicle response for beam structures without reference data. The first order mode shape with high spatial resolution in damaged state is extracted from the response measured on a moving vehicle via Hilbert transform (HT). Then regional mode shape curvature (RMSC) in damaged state which takes advantage of the high spatial resolution of mode shapes provided by moving vehicle test is defined to enhance the anti-noise ability. Subsequently the RMSC in undamaged state is estimated by the RMSC in damaged state and polynomial approximation under the assumption that RMSC in undamaged state has smooth surface. Finally an index is formulated based on RMSC before and after damage to localized damage. Numerical studies are conduced to investigate the effect of noise, moving velocity, uneven distribution of beam flexural rigidity, and road roughness on the accuracy of the proposed DLI.

Keywords: damage localization, mode shape, moving vehicle, beam structure, high spatial resolution