Vibration and multi-crack identification of Timoshenko beams under moving mass using the differential quadrature method

H. Chouiyakh, L. Azrar, K. Alnefaie, O. Akourri

www.elsevier.com/locate/ijmecsci

PII: S0020-7403(16)30786-X
DOI: http://dx.doi.org/10.1016/j.ijmecsci.2016.11.014
Reference: MS3493

To appear in: *International Journal of Mechanical Sciences*

Received date: 31 July 2016
Revised date: 9 November 2016
Accepted date: 14 November 2016

Cite this article as: H. Chouiyakh, L. Azrar, K. Alnefaie and O. Akourri Vibration and multi-crack identification of Timoshenko beams under moving mass using the differential quadrature method, *International Journal o Mechanical Sciences,* http://dx.doi.org/10.1016/j.ijmecsci.2016.11.014

Vibration and multi-crack identification of Timoshenko beams under moving mass using the differential quadrature method

H. Chouiyakh[1], L. Azrar[2,3*], K. Alnefaie[3], O. Akourri[1]

[1]Mathematical Modeling and Control, Faculty of Sciences and Techniques of Tangier, Abdelmalek Essaâdi University; Tangier; Morocco

[2]Laboratory LaMIPI, Higher School of Technical Education of Rabat (ENSET), Mohammed V University, Rabat, Morocco

[3]Mechanical Engineering Department, Faculty of Engineering, King Abdulaziz University, Jeddah, Saudi Arabia

Abstract

Methodological approaches for vibration analysis of multi-cracked Timoshenko beams under moving mass as well as for multi-crack identification based on the Huang Hilbert transform (HHT) have been elaborated. A multi-cracked Timoshenko beam is considered where the cracks are assumed to be open and modeled through rotational and translational springs. Due to multi-cracks and to the moving mass, a piecewise domain and coupling effects are resulted. To handle these effects, a methodological approach based on the differential quadrature method (DQM) is developed in space and time domains. A multimodal analysis and a numerical procedure based on the time-DQM are elaborated. Accurate results can be obtained with very few discretization points. Free and forced linear vibrations of thin and thick beams with an arbitrary number of cracks are investigated. Under moving mass with various speeds, the forced vibration responses are numerically obtained. Huang Hilbert transform, empirical mode decomposition and instantaneous frequencies are performed leading to an accurate multicrack identification for a large number of cracks. The identification process based on the forced time response is largely better than that based on eigenmodes and this identification can be highly improved by adjusting the mass and speed of the applied moving mass.

Keywords: Huang Hilbert transform; Timoshenko beam; Forced vibration response; Multicracks, Identification; Moving mass; DQM.