Nonlinear dynamics of an inclined beam subjected to a moving load

Mamandi, A.*, Kargarnovin, M.H.*, Younesian, D.*
* Mechanical and Aerospace Engineering Department, Science and Research Branch, Islamic Azad University, Tehran, Iran
* Mechanical Engineering Department, Sharif University of Technology, Tehran, Iran

Abstract

In this paper, the nonlinear dynamic response of an inclined pinned-pinned beam with a constant cross section, finite length subjected to a concentrated vertical force traveling with a constant velocity is investigated. The study is focused on the mode summation method and also on frequency analysis of the governing PDEs equations of motion. Furthermore, the steady-state response is studied by applying the multiple scales method. The nonlinear response of the beam is obtained by solving two coupled nonlinear PDEs governing equations of planar motion for both longitudinal and transverse oscillations of the beam. The dynamic magnification factor and normalized time histories of mid-span of the beam are obtained for various load velocity ratios and the outcome results have been illustrated and compared with the results obtained from standard linear solution. The appropriate parametric study considering the effects of the linear viscous damping, the dynamic response of the beam under the act of traveling load, beam inclination angle under zero or nonzero axial load are carried out to capture the influence of the effect of large deflections caused by stretching effects due to the beam’s immovable ends. It was seen that quadratic nonlinearity renders the softening effect on the dynamic response of the beam under the act of traveling load. Also in the case where the object leaves the inclined beam, its planar motion path is derived and the targeted accuracy is investigated and compared with those from the rigid solution assumption. Moreover, the stability analysis of steady-state response for the modes equations having quadratic nonlinearity was carried out and it was observed from the frequency response curves that for the considered parameters in the case of internal-external primary resonance, both saturation phenomenon and jump phenomenon can be predicted for the longitudinal excitation. © Springer Science+Business Media B.V. 2009.

Language of original document

English

Author keywords

Frequency response analysis; Inclined beam; Mode summation method; Multiple scales method; Nonlinear vibrations; Quadratic nonlinearity

Index Keywords

Frequency response analysis; Inclined beams; Multiple scales methods; Non-linear vibrations; Quadratic nonlinearity

Engineering controlled terms: Aircraft engines; Control nonlinearities; Damping; Dynamic response; Equations of motion; Frequency response; Loads (forces); Nonlinear analysis; Problem solving; Vibration analysis; Vibration control

Engineering main heading: Nonlinear equations

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Nonlinear Dynamics
Volume 60, Issue 3, May 2010, Pages 277-293