

Nonlinear vibrations of an inclined beam subjected to a moving load

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In this paper, the nonlinear dynamic responses of an inclined pinned-pinned Euler-Bernoulli beam with a constant cross section and finite length subjected to a concentrated vertical force traveling with constant velocity is investigated by using the mode summation method. Frequency analysis of the PDE's governing equations of motion for steady-state response is studied by applying multiple scales method. The nonlinear dynamic deflections of the beam are obtained by solving two coupled nonlinear PDE's governing equations of planar motion for both longitudinal and transverse oscillations of the beam. The dynamic magnification factor and normalized time histories of mid-point of the beam are obtained for various load velocity ratios and the numerical results are compared with those obtained from traditional linear solution. It is found that quadratic nonlinearity renders the softening effect on the dynamic response of the beam under the act of traveling load. Also stability analysis of the steady-state response for the modes equations having quadratic nonlinearity is carried out and it is observed from the amplitude response curves that for the case of internal-external primary resonance, both saturation phenomenon and jump phenomenon are predicted for the longitudinal excitation. © 2009 IOP Publishing Ltd.