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Super Harmonic Nonlinear Lateral Vibration of an Axially Moving Beam with Rotating Prismatic Joint

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Abstract : The motion of an axially moving beam with rotating prismatic joint with a tip mass on the end is analyzed to investigate the nonlinear vibration and dynamic stability of the beam. The beam is moving with a harmonic axially and rotating velocity about a constant mean velocity. A time-dependent partial differential equation and boundary conditions with the aid of the Hamilton principle are derived to describe the beam lateral deflection. After the partial differential equation is discretized by the Galerkin method, the method of multiple scales is applied to obtain analytical solutions. Frequency response curves are plotted for the super harmonic resonances of the first and the second modes. The effects of non-linear term and mean velocity are investigated on the steady state response of the axially moving beam. The results are validated with numerical simulations.

Keywords : super harmonic resonances, non-linear vibration, axially moving beam, Galerkin method
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