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Vibration suppression of rotating beams using time-varying internal tensile force

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Abstract

A new strategy for vibration suppression of a rotating beam using a time-increasing internal tensile force is proposed in this paper. Nonlinear coupled longitudinal and bending equations of motion are derived in non-dimensional form using the Hamilton principle. The first-order analytical solution of the equations of motion is obtained using the Galerkin technique combined with the multiple scales method (MSM). Numerical simulations are then performed for various increasing rates of the internal tensile force and performance of the vibration suppression strategy is studied. A very close agreement between the simulation results obtained by the numerical integration and the first-order analytical solution is achieved. Forced vibrations of the system for input excitations of either a sinusoidal or a random function with white noise time history are considered. The simulation results and dynamic performance of the suppressed system for an externally excited rotating beam show an interesting phenomenon of the form of remarkable effectiveness of the proposed vibration reduction strategy. © 2010 Elsevier Ltd. All rights reserved.

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Analytical solutions; Dynamic performance; First-order; Forced vibration; Galerkin technique; Hamilton principle; Multiple scales methods; New strategy; Numerical integrations; Numerical simulation; Random functions; Rotating beam; Simulation result; Tensile forces; Time history; Time varying; Vibration reductions; Vibration suppression
Engineering controlled terms: Integration; Mechanics; Nonlinear equations; Rotation; White noise
Engineering main heading: Equations of motion

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