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Nonlinear vibration of a three-dimensional moving gantry crane subjected to a travelling trolley hoisting a swinging object

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Abstract

Nonlinear vibration of a three-dimensional moving gantry crane carrying a trolley hoisting a swinging object is studied in this paper.A finite element method is used to solve nonlinear coupled governing equations of the structure. A combinational technique (Newmark-Runge-Kutta) is employed for direct integration procedure. To develop a comprehensive parametric study and sensitivity analysis of the coupled nonlinear system, sequence of numerical simulations are carried out. Parametric study is directed to find out how different parameters like speed and acceleration of the trolley and gantry crane as well as the mass of the moving trolley and swinging object may affect the linear and nonlinear responses of the structure. It is found that the nonlinearity arises from large amplitude of three-dimensional motion of the swinging object.

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Index Keywords

Combinational technique; Coupled nonlinear systems; Direct integration; Governing equations; Large amplitude; Non-linear response; Non-linear vibrations; Non-Linearity; Numerical simulation; Parametric study; Runge-Kutta; Swinging object; Three-dimensional motion
Engineering controlled terms: Coupled circuits; Finite element method; Gantry cranes; Runge Kutta methods; Sensitivity analysis; Three dimensional
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