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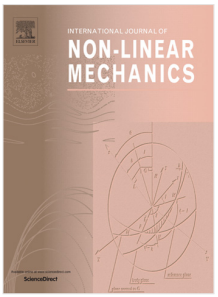

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Nonlinear dynamic responses of an axially moving laminated beam subjected to both blast and thermal loads

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Abstract

The nonlinear dynamic responses of an axially moving laminated beam subjected to a blast load in thermal environment is studied considering large-displacement. Firstly, the nonlinear dynamic equilibrium equation is established based on the large-displacement theory and the constitutive relation of the single layer material in thermal environment. Based on the Galerkin method, a set of ordinary differential equations is obtained. Secondly, the multiple scales method is adopted to get the nonlinear free vibration frequency. Then, the stability region of the axial velocity and temperature is derived and the truncation order is approximated by the convergence calculation of the natural frequencies. Finally, numerical calculations are performed to discuss the effects of different kinds of blast loads, axial velocity and temperature on the nonlinear dynamic responses adopting the Runge-Kutta technique.

Keywords: thermal environment; blast load; axially moving; laminated beam

1. Introduction

Laminated structures are generally used in aircraft, space station, car and submarine. The laminated beam is one of them, and it is sometimes in an axially moving condition, such as paper sheets, band-saws, pipes conveying fluid, robot arms, automobiles and aerospace structures. Because the working environment of these structures is different, it is sometimes affected by thermal environment and the blast load. Therefore, it is significance to study the dynamic behavior of such a structure.

The vibrations of axially moving systems have been investigated for many years and still of great concern today. The first studies on the dynamics of axially moving continua system can be dated back to the year of 1950. Initially, they are mainly concerned with the vibrations of

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