Control of Dynamic Response of Thin-Walled Composite Beams using Structural Tailoring and Piezoelectric Actuation

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(ABSTRACT)

A dual approach integrating structural tailoring and adaptive materials technology and designed to control the dynamic response of cantilever beams subjected to external excitations is addressed. The cantilevered structure is modeled as a thin-walled beam of arbitrary cross-section and incorporates a number of non-classical effects such as transverse shear, warping restraint, anisotropy of constituent materials and heterogeneity of the construction.

Whereas structural tailoring uses the anisotropy properties of advanced composite materials, adaptive materials technology exploits the actuating/sensing capabilities of piezoelectric materials bonded or embedded into the host structure. Various control laws relating the piezoelectrically-induced bending moment with combined kinematical variables characterizing the response at given points of the structure are implemented and their effects on the closed-loop frequencies and dynamic response to external excitations are investigated. The combination of structural tailoring and control by means of adaptive materials proves very effective in damping out vibration.

In addition, the influence of a number of non-classical effects characterizing the structural model on the open and closed-loop dynamic responses have been considered and their role assessed.

Dedicated

to my Father and Mother

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