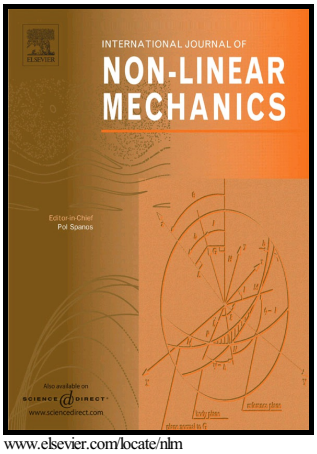

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A. Casalotti, W. Lacarbonara

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Tailoring of Pinched Hysteresis for Nonlinear Vibration Absorption via Asymptotic Analysis

A. Casalotti and W. Lacarbonara

Department of Structural and Geotechnical Engineering, Sapienza University of Rome

Abstract

The method of multiple scales is adopted to investigate the dynamic response of a nonlinear Vibration Absorber (VA) whose constitutive behavior is governed by hysteresis with pinching. The asymptotic analysis is first devoted to study the response of the absorber to harmonic excitations and to evaluate its sensitivity to the main constitutive parameters. The frequency response obtained in closed form allows to carry out the stability analysis together with a parametric study leading to behavior charts characterizing multi-valued softening/hardening responses or single-valued, quasi-linear responses. A two-degree-of-freedom model of a primary nonlinear structure endowed with the hysteretic vibration absorber is investigated to explore transfers of energy from the structure to the absorber resulting into optimal vibration amplitude reduction. The asymptotic solution is proved to be in good agreement with the numerical solution obtained via continuation. The asymptotic approach is embedded into a differential evolutionary algorithm to obtain a multi-parameter optimization procedure by which the optimal hysteresis parameters are found.

Keywords: Nonlinear Passive Control, Vibration Absorber, Hysteresis, Pinching, Method of Multiple Scales

1. Introduction

In the field of vibration control, often the systems to protect behave nonlinearly. The study of nonlinear control systems has thus become of great interest. Moreover, the wider number of design parameters, together with the possibility of exploiting advantageously nonlinear dynamic phenomena associated with nonlinear controllers and their interactions with the main