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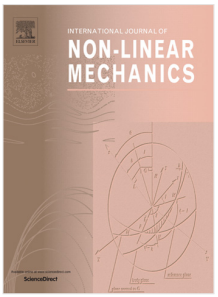

Experimental identification of hardening and softening nonlinearity in circular laminated plates

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Experimental Identification of Hardening and Softening Nonlinearity in Circular Laminated Plates

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Abstract: This work investigates nonlinear characteristics of a circular laminated plate. A nonparametric identification method based on the Hilbert transform is applied to identify the nonlinear system. The results demonstrate that the force-displacement curve has a soft nonlinear characteristic under small displacements and a hard nonlinear characteristic under large displacements. The force-velocity curve also has a soft nonlinear characteristic. A circular isotropic plate is treated to test the method. The force-state method is adopted to confirm the identification results. The effects of the plate diameter are examined. A combination of a cubic polynomial and a hyperbolic tangent function is proposed to fit the experiment data. The fitting results are verified by time domain simulations under random excitations. The work illustrates some novel nonlinear characteristics in transverse vibration of a circular laminated plate via a nonlinear system identification process.

Keywords: Nonlinearity; Circular laminated plate; Non-parametric identification; Hilbert transform

1. Introduction

A circular laminated plate (also called sandwich plate or bimorph) manufactured by a brass plate and two piezoelectric plates is an effective structure in piezoelectric actuators [1] and energy harvesters [2, 3]. As a consequence of its fundamental role in the electromechanical devices, the modeling of the circular laminated plate is worthy of careful investigations. Previous researches

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