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Changing the Nonlinear Resonant Response of an Asymmetric Mono-stable Oscillator by Injecting a Hard High-Frequency Harmonic Excitation

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Abstract

Nonlinearity is an unvoidable intrinsic property of most dynamical systems. Its mere presence can be detrimental to the performance of many devices since it often complicates the response behavior of the device by introducing multi-valued and aperiodic responses. As such, the ability to passively alter and control the nonlinearity can be of utmost importance for the design of many sensors and actuators. In this paper, we demonstrate that the effective nonlinearity associated with the resonant dynamics of a mono-stable asymmetric oscillator can be adjusted by injecting a hard high-frequency non-resonant excitation. We study the dependence of the effective nonlinearity of the slow dynamics on the hard excitation magnitude and highlight the important design parameters controlling this behavior. We also show that the slow resonant dynamics of the oscillator can be locally linearized by choosing the proper hard excitation parameters.

1 Introduction

Nonlinearity is an unvoidable intrinsic property of most dynamical systems. Most mechanical oscillators exhibit a nonlinear response behavior when the amplitude of their response increases. Such nonlinearity can arise from different sources but is often attributed to the oscillator's geometry, material properties, and/or the boundary conditions [1]. Since the nonlinearity complicates the response of the system by introducing multi-valued and aperiodic responses, achieving a linear response can be of utmost importance for the readability and calibration of many electro-mechanical sensors and actuators.

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