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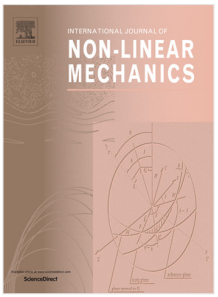

Externally excited undamped and damped linear and nonlinear oscillators: Exact solutions and tuning to a desired exact form of the response

Ivana Kovacic

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Externally excited undamped and damped linear and nonlinear oscillators: exact solutions and tuning to a desired exact form of the response

Ivana Kovacic

University of Novi Sad, Faculty of Technical Sciences,
Centre of Excellence for Vibro-Acoustic Systems and Signal Processing,
21000 Novi Sad, Serbia
E-mail: ivanakov@uns.ac.rs; Tel. +381 21 485 2241

Abstract

This work presents a methodology on how to use exact closed-form solutions for the response of free undamped linear and nonlinear oscillators to design the external excitation of undamped or damped nonlinear oscillators to get such steady-state response. A variety of examples, including Duffing-type oscillators and purely nonlinear oscillators, are given to illustrate this methodology.

Keywords: simple harmonic oscillator; Duffing-type oscillators; purely nonlinear oscillator; external excitation.

1 Introduction

Tuned oscillators have been widely investigated and utilized in labs and practice for different purposes, such as, for example: vibration absorbers [1] - [3], isolators [4] - [6], energy harvesters [7] - [9], resonators [10], [11], metamaterials/metastructures [12], [13], etc. In the majority of cases, tuning has been aimed at yielding a desired amplitude at certain excitation frequency or within a certain frequency range.

This study presents a different approach in which the external excitation is designed to achieve a desired *form* of the response, both regarding the amplitude and the frequency content

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