SOLID MECHANICS AND ITS APPLICATIONS

G. Rega and F. Vestroni (Eds.)

IUTAM Symposium on

Chaotic Dynamics and Control of Systems and Processes in Mechanics

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SOLID MECHANICS AND ITS APPLICATIONS
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Aims and Scope of the Series

The fundamental questions arising in mechanics are: *Why?, How?,* and *How much?* The aim of this series is to provide lucid accounts written by authoritative researchers giving vision and insight in answering these questions on the subject of mechanics as it relates to solids.

The scope of the series covers the entire spectrum of solid mechanics. Thus it includes the foundation of mechanics; variational formulations; computational mechanics; statics, kinematics and dynamics of rigid and elastic bodies: vibrations of solids and structures; dynamical systems and chaos; the theories of elasticity, plasticity and viscoelasticity; composite materials; rods, beams, shells and membranes; structural control and stability; soils, rocks and geomechanics; fracture; tribology; experimental mechanics; biomechanics and machine design.

The median level of presentation is the first year graduate student. Some texts are monographs defining the current state of the field; others are accessible to final year undergraduates; but essentially the emphasis is on readability and clarity.

For a list of related mechanics titles, see final pages.

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NONLINEAR DYNAMICS OF A HEAVY MATERIAL PARTICLE ALONG A CIRCLE WHICH ROTATES AND OPTIMAL CONTROL

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Abstract: In this paper some research results of fascinating nonlinear dynamics of a heavy material particle along circles with coupled rotations, with many different properties of nonlinear dynamics and optimal control of this dynamics, are presented. By using MathCad software, visualizations of nonlinear dynamical processes in such rheonomic systems are made.

Key words: Nonlinear dynamics, coupled rotation, material particle, optimal control, homoclinic orbit, trigger, coupled singularities, bifurcation, phase plane portrait, separatrix layering, separatrix in the form of number eight.

1. Introduction

Dynamics of coupled rotors is a very old engineering problem with many different research results and discoveries of new nonlinear phenomena (see Refs. [1], [2] and [3]), and of stationary and nonstationary vibrations regimes (see Ref. [4]) with different kinetic parameters of the dynamical system. However, even nowadays many researchers pay attention to this problem, and again arises interest in doing research on nonlinear dynamics of coupled rotors (see Refs. [5], [6], [7], [8]) by using new analytical, numerical and experimental methods to discover properties of nonlinear dynamics and finer possibilities for controlling nonlinear phenomena, instabilities and non stationary regimes as well as the appearance of chaotic-like and stochastic-like processes. One of the reasons for researching on this problem by means of analytical and numerical methods applied to a not too complicated model is that it is already very good for pointing out the complexity of multifrequency regimes in nonlinear systems, since it undergoes many different regimes with sensitive dependence of dynamical system properties and nonstationary processes on the system kinetic

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The interest of the applied mechanics community towards chaotic dynamics of engineering systems has exploded in the last fifteen years. Today, it is generally accepted that nonlinear vibration problems of advanced systems should be addressed through the combined use of analytical, computational, geometrical and experimental approaches, and also by paying attention to the interaction with control features.

The outstanding points of these proceedings are a coherent compendium of the current state of theory and applications of nonlinear and chaotic dynamics in mechanics, along with their control. Subject areas include: bifurcation and chaos, mechanical and structural systems, nonsmooth dynamics, delay and random systems, control of systems and processes, synchronization and control of chaos.

Major achievements are highlighted as regards: complex systems and processes for classical and innovative applications, features of nonlinear interactions, patterns of novel bifurcations of non-smooth systems, dimensionality and reduced-order models of continuous systems, exploitation of dynamical systems properties for applications, implications of chaos for design and operating conditions, control of spatio-temporal dynamics.

For scientists from engineering and physics communities this book will provide first-hand information on recent developments in nonlinear dynamics, chaos and control of mechanical systems and processes.

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