Analysis Of Complex Nonlinear Mechanical Systems A Computer Algebra Assisted Approach World Scientific Series On Nonlinear Science Series A

Authoritative and visionary, this festschrift features 12 highly readable expositions of virtually all currently active aspects of nonlinear science. It has been painstakingly researched and written by leading scientists and eminent expositors, including L Shilnikov, R Seydel, I Prigogine, W Porod, C Mira, M Lakshmanan, W Lauterborn, A Holden, H Haken, C Grebogi, E Doedel and L Chua; each chapter addresses a current and intensively researched area of nonlinear science and chaos, including nonlinear dynamics, mathematics, numerics and technology. Handsomely produced with high resolution color graphics for enhanced readability, this book has been carefully written at a high level of exposition and is somewhat self-contained. Each chapter includes a tutorial and background information, as well as a survey of each area's main results and state of the art. Of special interest to both beginners and seasoned researchers is the identification of future trends and challenging yet tractable problems that are likely to be solved before the end of the 21st century. The visionary and provocative nature of this book makes it a valuable and lasting reference. Contents:Chua's Circuit and the Qualitative Theory of Dynamical Systems (C Mira)Nonlinear Science and the Laws of Nature (I Prigogine)Visions of Synergetics (H Haken)Mathematical Problems of Nonlinear Dynamics: A Tutorial (L Shilnikov)Experimental Nonlinear Physics (W Lauterborn et al.)Nonlinear Physics: Integrability, Chaos and Beyond (M Lakshmanan)Nonlinear Science: The Impact of Biology (A V Holden)Nonlinear Computation (R Seydel)Nonlinear Numerics (E Doedel)Some Historical Aspects of Nonlinear Dynamics: Possible Trends for the Future (C Mira)Control and Applications of Chaos (C Grebogi et al.)Quantum Dot Devices and Quantum-Dot Cellular Automata (W Porod)CNN: A Paradigm for Complexity (L O Chua) Readership: Nonlinear scientists. Keywords:Chua's Circuit;Qualitative Theory;Dynamical Systems;Nonlinear Science;Laws of Nature;Visions of Synergetics;Experimental Nonlinear Physics;Nonlinear Dynamics;Nonlinear Physics;Integrability;Chaos;Nonlinear Computation;Nonlinear Numerics;Control of Chaos;Applications of Chaos;Quantum Dot Devices;Quantum-Dot Cellular Automata;CNN;Cellular Neural Networks

Analysis of Complex Nonlinear Mechanical SystemsA Computer Algebra Assisted ApproachWorld Scientific

This book evaluates the seismic performance of concrete gravity dams, considering the effects of strong motion duration, mainshock-aftershock seismic sequence, and near-fault ground motion. It employs both the extended finite element method (XFEM) and concrete damaged plasticity (CDP) models to characterize the mechanical behavior of concrete gravity dams under strong ground motions, including the dam-reservoir-foundation interaction. In addition, it discusses the effects of the initial crack, earthquake direction, and cross-stream seismic excitation on the nonlinear dynamic response to strong ground motions, and on the damage-cracking risk of concrete gravity dams. This book provides a theoretical basis for the seismic performance evaluation of high dams, and can also be used as a reference resource for researchers and graduate students engaged in the seismic design of high dams.

The basic procedures for designing and analysing electronic systems are based largely on the assumptions of linear behavior of the system. Nonlinearities inherent in all real applications very often cause unexpected and even strange behavior. This book presents an electronic engineer's perspective on chaos and complex behavior. It starts from basic mathematical notions which enable understanding of the observed phenomena, and guides the reader through the methodology and tools used in the laboratory and numerical experiments to interpretation and explanation of basic mechanisms. On typical circuit examples, it shows how the theoretical and empirical developments can be used in practice. Attention is drawn to applications of chaotic circuits as noise generators and the possible use of synchronized chaotic systems in information transmission and encryption. Chaos control is considered as a new, emerging area where electronic equipment and chaos theory could turn vital in biomedical and engineering issues.

Applications of Chaos and Nonlinear Dynamics in Engineering -

Nonlinear Mechanics, Second Edition

Newtonian Nonlinear Dynamics for Complex Linear and Optimization Problems

Harmonic Balance for Nonlinear Vibration Problems

Nonlinear Solid Mechanics for Finite Element Analysis: Statics

Analysis of Complex Nonlinear Mechanical Systems

A clear and complete postgraduate introduction to the theory and computer programming for the complex simulation of material behavior.

Bifurcation and Chaos has dominated research in nonlinear dynamics for over two decades and numerous introductory and advanced books have been published on this subject. There remains, however, a dire need for a textbook which provides a pedagogically appealing yet rigorous mathematical bridge between these two disparate levels of exposition. This book is written to serve the above unfulfilled need. Following the footsteps of Poincaré, and the renowned Andronov school of nonlinear oscillations, this book focuses on the qualitative study of high-dimensional nonlinear dynamical systems. Many of the qualitative methods and tools presented in this book were developed only recently and have not yet appeared in a textbook form. In keeping with the self-contained nature of this book, all topics are developed with an introductory background and complete mathematical rigor. Generously illustrated and written with a high level of exposition, this book will appeal to both beginners and advanced students of nonlinear dynamics interested in learning a rigorous mathematical foundation of this fascinating subject. Contents:Basic ConceptsStructurally Stable Equilibrium States of Dynamical SystemsStructurally Stable Periodic Trajectories of Dynamical SystemsInvariant ToriCenter Manifold. Local CaseCenter Manifold. Non-Local Case Readership: Engineers, students, mathematicians and researchers in nonlinear dynamics and dynamical systems. Keywords:Bifurcations;Dynamical Systems;Qualitative Theory;Chaos;Strange Attractors;Nonlinear DynamicsReviews: "It is well-written and clearly organized with excellent figures … This rigorous book, with its emphasis on mathematical technique, would form an excellent basis for an engineering course if supplemented with applications." Applied Mechanics Reviews "Short remarks concerning various, not only mathematical, aspects of the theory add an extra flavour to the text. I recommend the book for all persons interested in the qualitative theory of differential equations." Mathematical Reviews

This book compiles recent research in the field of nonlinear dynamics, vibrations and damping applied to engineering structures. It addresses the modeling of nonlinear vibrations in beams, frames and complex mechanical systems, as well as the modeling of damping systems and viscoelastic materials applied to structural dynamics. The book includes several chapters related to solution techniques and signal analysis techniques. Last but not least, it deals with the identification of nonlinear responses applied to condition monitoring systems.

Nonlinear Dynamics, Volume 1. Proceedings of the 33rd IMAC, A Conference and Exposition on Balancing Simulation and Testing, 2015, the first volume of ten from the Conference brings together contributions to this important area of research and engineering. The collection presents early findings and case studies on fundamental and applied aspects of Structural Dynamics, including papers on: Nonlinear Oscillations Nonlinear Simulation Using Harmonic Balance Nonlinear Modal Analysis Nonlinear System Identification Nonlinear Modeling & Simulation Nonlinearity in Practice Nonlinear Systems Round Robin on Nonlinear System Identification.

Controlling and Synchronization

Parameter Identification and Monitoring of Mechanical Systems Under Nonlinear Vibration

Review of LWR Fuel System Mechanical Response with Recommendations for Component Acceptance Criteria

Proceedings of the 33rd IMAC, A Conference and Exposition on Structural Dynamics, 2015

Nonlinear Mechanics of Complex Structures

Festschrift Dedicated to Leon O Chua on the Occasion of His 60th Birthday

Complicated problems in nonlinear mechanics pose a challenge - many cannot be solved with existing closed-form methods. You would probably like easier methods for obtaining analytical and numerically exact solutions for finite elements, updated or total Lagrangian formulation, and arc-length methods of nonlinear elastic problem solving. Nonlinear Mechanics, Second Edition gives you what you want - convenient methods of analysis and valuable data for comparison. This is the only book to offer a comprehensive treatment of structural components with variable thickness and a variable modulus of elasticity. It is also the only one to cover closed-form solutions for the dynamic and inelastic analysis of members and plates that are subjected to small and large deformations by including axial and vertical restraints. The author uses exact and approximate solutions for static, dynamic, and inelastic analysis. It also discusses aspects of nonlinear vibration of elastically supported beams, nonlinear response of nonuniform rotor blades, and a new concept of airfoil design. With more than 30% updated and new material, this edition is revised and reorganized to meet the needs of both academia and industry. Easy-to-follow equation derivations, example problems, step-by-step procedures, and iterative approaches create a thorough reference that fills present needs and equips you for the challenges of the future.

* Explains the physical meaning of linear and nonlinear structural mechanics. * Shows how to perform nonlinear structural analysis. * Points out important nonlinear structural dynamics behaviors. * Provides ready-to-use governing equations.

Bifurcation and Chaos has dominated research in nonlinear dynamics for over two decades and numerous introductory and advanced books have been published on this subject. There remains, however, a dire need for a textbook which provides a pedagogically appealing yet rigorous mathematical bridge between these two disparate levels of exposition. This book is written to serve the above unfulfilled need. Following the footsteps of Poincare, and the renowned Andronov school of nonlinear oscillations, this book focuses on the qualitative study of high-dimensional nonlinear dynamical systems. Many of the qualitative methods and tools presented in this book were developed only recently and have not yet appeared in a textbook form. In keeping with the self-contained nature of this book, all topics are developed with an introductory background and complete mathematical rigor. Generously illustrated and written with a high level of exposition, this book will appeal to both beginners and advanced studentsof nonlinear dynamics interested in learning a rigorous mathematical foundation of this fascinating subject.

Newtonian Nonlinear Dynamics for Complex Linear and Optimization Problems explores how Newton's equation for the motion of one particle in classical mechanics combined with finite difference methods allows creation of a mechanical scenario to solve basic problems in linear algebra and programming. The authors present a novel, unified numerical and mechanical approach and an important analysis method of optimization.

Chaos and Complexity in Nonlinear Electronic Circuits

Developments and Novel Approaches in Nonlinear Solid Body Mechanics

(Part I)

Seismic Performance Analysis of Concrete Gravity Dams

Lectures in Synergetics

From Theory to Engineering Applications

In recent years, enormous progress has been made on nonlinear dynamics particularly on chaos and complex phenomena. This unique volume presents the advances made in theory, analysis, numerical simulation and experimental realization, promising novel practical applications on various topics of current interest on chaos and related fields of nonlinear dynamics. Particularly, the focus is on the following topics: synchronization vs. chaotic phenomena, chaos and its control in engineering dynamical systems, fractal-based dynamics, uncertainty and unpredictability measures vs. chaos, Hamiltonian systems and systems with time delay, local/global stability, bifurcations and their control, applications of machine learning to chaos, nonlinear vibrations of lumped mass mechanical/mechatronic systems (rigid body and coupled oscillator dynamics) governed by ODEs and continuous structural members (beams, plates, shells) vibrations governed by PDEs, patterns formation, chaos in micro- and nano-mechanical systems, chaotic reduced-order models, energy absorption/harvesting from chaotic, chaos vs. resonance phenomena, chaos exhibited by discontinuous systems, chaos in lab experiments. The present volume forms an invaluable source on recent trends in chaotic and complex dynamics for any researcher and newcomers to the field of nonlinear dynamics.

This book contains a systematic study of ecological communities of two or three interacting populations. Starting from the Lotka-Volterra system, various regulating factors are considered, such as rates of birth and death, predation and competition. The different factors can have a stabilizing or a destabilizing effect on the community, and their interplay leads to increasingly complicated behavior. Studying and understanding this path to greater dynamical complexity of ecological systems constitutes the backbone of this book. On the mathematical side, the tool of choice is the qualitative theory of dynamical systems — most importantly bifurcation theory, which describes the dependence of a system on the parameters. This approach allows one to find general patterns of behavior that are expected to be observed in ecological models. Of special interest is the reaction of a given model to disturbances of its present state, as well as to changes in the external conditions. This leads to the general idea of "dangerous boundaries" in the state and parameter space of an ecological system. The study of these boundaries allows one to analyze and predict qualitative and often sudden changes of the dynamics — a much-needed tool, given the increasing antropogenic load on the biosphere.As a spin-off from this approach, the book can be used as a guided tour of bifurcation theory from the viewpoint of application. The interested reader will find a wealth of intriguing examples of how known bifurcations occur in applications. The book can in fact be seen as bridging the gap between mathematical biology and bifurcation theory.

This monograph presents an introduction to Harmonic Balance for nonlinear vibration problems, covering the theoretical basis, its application to mechanical systems, and its computational implementation. Harmonic Balance is an approximation method for the computation of periodic solutions of nonlinear ordinary and differential-algebraic equations. It outperforms numerical forward integration in terms of computational efficiency often by several orders of magnitude. The method is widely used in the analysis of nonlinear systems, including structures, fluids and electric circuits. The book includes solved exercises which illustrate the advantages of Harmonic Balance over alternative methods as well as its limitations. The target audience primarily comprises graduate and post-graduate students, but the book may also be beneficial for research experts and practitioners in industry.

The IUT AM / IFToMM Symposium on Synthesis of Nonlinear Dynamical Systems, held in Riga, Latvia, 24-28 August 1998, was one of a series of IUTAM sponsored symposia which focus on the theory and application of methods of nonlinear dynamics in mechanics. The symposium follows eighteen symposia on Analysis and Synthesis of Nonlinear Mechanical Oscillatory Systems held at Riga Technical University from 1971 to 1991 and in 1996 (prof. E. Lavendelis and Prof. M. Zakrzhevsky). Early in the late fifties and sixties Prof. J. G. Panovko organised several successful conferences in Riga on Nonlinear Oscillations. The participants in all these conferences and symposia (except 1996) were only from the ex-Soviet Union. This symposium, organised by the Institute of Mechanics of Riga Technical University, brought together scientists active in different fields of nonlinear dynamics. Selected scientists from 14 countries represented a wide range of expertise in' mechanics, from pure theoreticians to people primarily oriented towards application of nonlinear and chaotic dynamics and nonlinear oscillations. The goal of the symposium was to stimulate development of the theory of strongly nonlinear dynamical systems and its new applications in the fields of applied mechanics, engineering and other branches of science and technology.

Nonlinear Dynamics, Volume 1

NARMAX Methods in the Time, Frequency, and Spatio-Temporal Domains

IUTAM / IFToMM Symposium on Synthesis of Nonlinear Dynamical Systems

Proceedings of the IUTAM / IFToMM Symposium held in Riga, Latvia, 24–28 August 1998

Mechanics, Design Engineering and Advanced Manufacturing

A Computational Approach

LINEAR and NONLINEAR INSTABILITIES in MECHANICAL SYSTEMS An in-depth insight into nonlinear analysis and control As mechanical systems become lighter, faster, and more flexible, various nonlinear instability phenomena can occur in practical systems. The fundamental knowledge of nonlinear analysis and control is essential to engineers for analysing and controlling nonlinear instability phenomena. This book bridges the gap between the mathematical expressions of nonlinear dynamics and the corresponding practical phenomena. Linear and Nonlinear Instabilities in Mechanical Systems: Analysis, Control and Application provides a detailed and informed insight into the fundamental methods for analysis and control for nonlinear instabilities from the practical point of view. Key features: Refers to the behaviours of practical mechanical systems such as aircraft, railway vehicle, robot manipulator, micro/nano sensor Enhances the rigorous and practical understanding of mathematical methods from an engineering point of view The theoretical results obtained by nonlinear analysis are interpreted by using accompanying videos on the real nonlinear behaviors of nonlinear mechanical systems Linear and Nonlinear Instabilities in Mechanical Systems is an essential textbook for students on engineering courses, and can also be used for self-study or reference by engineers.

Nonlinear System Identification: NARMAX Methods in the Time, Frequency, and Spatio-Temporal Domains describes a comprehensive framework for the identification and analysis of nonlinear dynamic systems in the time, frequency, and spatio-temporal domains. This book is written with an emphasis on making the algorithms accessible so that they can be applied and used in practice. Includes coverage of: The NARMAX (nonlinear autoregressive moving average with exogenous inputs) model The orthogonal least squares algorithm that allows models to be built term by term where the error reduction ratio reveals the percentage contribution of each model term Statistical and qualitative model validation methods that can be applied to any model class Generalised frequency response functions which provide significant insight into nonlinear behaviours A completely new class of filters that can move, split, spread, and focus energy The response spectrum map and the study of sub harmonic and severely nonlinear systems Algorithms that can track rapid time variation in both linear and nonlinear systems The important class of spatio-temporal systems that evolve over both space and time Many case study examples from modelling space weather, through identification of a model of the visual processing system of fruit flies, to tracking causality in EEG data are all included to demonstrate how easily the methods can be applied in practice and to show the insight that the algorithms reveal even for complex systems NARMAX algorithms provide a fundamentally different approach to nonlinear system identification and signal processing for nonlinear systems. NARMAX methods provide models that are transparent, which can easily be analysed, and which can be used to solve real problems. This book is intended for graduates, postgraduates and researchers in the sciences and engineering, and also for users from other fields who have collected data and who wish to identify models to help to understand the dynamics of their systems.

The world that surrounds us is a complex system of interacting objects. The versatility of the links and interactions brings about the infinite multiplicity of natural phenomena. "Synergetics" studies nonlinear nonequilibrium processes and self-organization phenomena, allowing for description, systematization and generalization of the phenomena that are described by the different branches of natural science: physics, chemistry, biology, as well as sociology and economics. This book introduces the reader to the exciting world of the nonlinear phenomena that are studied in synergetics. The book comprises treatises on mathematical methods for the study of nonequilibrium processes and presents versatile phenomena studied in synergetics: multistability, self-oscillation, spatial stratification, autowaves, kinetic phase transitions and chaos. Examples of self-organization in physics, chemistry, biology covered in this volume include laser generation, optical bistability, self-oscillations in semiconductors and chemical reactions, spatial stratification in hydrodynamics and in crystals, auto-waves in semiconductors and nerve fibers and many other phenomena. The majority of the phenomena considered occur in physics but the book is also useful for chemists and biologists. Contents:Mathematical Fundamentals of the Self-OrganizationStatic InstabilitiesProcesses of Self-OscillationsThermoconcentrational InstabilitiesSpatial StructuresAuto-WavesStochastic Processes Readership: Students and researchers in theoretical physics, thermodynamics, chaos, dynamical systems and applied physics. Keywords:Self-Organization;Instabilities;Spatial Structures;Auto-Waves;Stochastic Processes;Chaos;Organic Crystals;Semiconductors;Exciton;Radiation Defects

Chaos and nonlinear dynamics initially developed as a new emergent field with its foundation in physics and applied mathematics. The highly generic, interdisciplinary quality of the insights gained in the last few decades has spawned myriad applications in almost all branches of science and technology—and even well beyond. Wherever quantitative modeling and analysis of complex, nonlinear phenomena is required, chaos theory and its methods can play a key role. This volume concentrates on reviewing the most relevant contemporary applications of chaotic nonlinear systems as they apply to the various cutting-edge branches of engineering. The book covers the theory as applied to robotics, electronic and communication engineering (for example chaos synchronization and cryptography) as well as to civil and mechanical engineering, where its use in damage monitoring and control is explored). Featuring contributions from active and leading research groups, this collection is ideal both as a reference and as a 'recipe book' full of tried and tested, successful engineering applications

Nonlinear Dynamics of Interacting Populations

Chaos in Nonlinear Oscillators

Dynamical Chaos

Theory and Applications for the Life-, Neuro- and Natural Sciences

Nonlinear System Identification

Essays, Critical, Chaotic, and Otherwise

This book is a compilation of the review papers, expositions and some of the technical works of Leo Kadanoff, a theoretical physicist. The objective is to put together a group of not-too-technical writing in which he discusses some issues in condensed matter physics, hydrodynamics, applied mathematics and national policy.This expanded edition is divided into five sections. The first section contains review papers on hydrodynamics, condensed matter physics and field theory. Next is a selection of papers on scaling and universality, particularly as applied to phase changes. A change of pace is provided by a series of papers on the critical analysis of simulation models of urban economic and social development. The book concludes with a series of recent papers on complex patterns. Each major section has an introduction designed to tie the work together and to provide perspective on the subject matter.

This book deals with the bifurcation and chaotic aspects of damped and driven nonlinear oscillators. The analytical and numerical aspects of the chaotic dynamics of these oscillators are covered, together with appropriate experimental studies using nonlinear electronic circuits. Recent exciting developments in chaos research are also discussed, such as the control and synchronization of chaos and possible technological applications.

This book is an introductory course to accelerator physics at the level of graduate students. It has been written for a large audience which includes users of accelerator facilities, accelerator physicists and engineers, and undergraduates aiming to learn the basic principles of construction, operation and applications of accelerators.The new concepts of dynamical systems developed in the last twenty years give the theoretical setting to analyse the stability of particle beams in accelerator. In this book a common language to both accelerator physics and dynamical systems is integrated and developed, aiming to eliminate the difficulties faced by accelerator physicists, engineers and applied mathematicians when they try to join efforts in the attempt to control the nonlinearities disturbing particle beams.

During the past decade we have had to confront a series of control design prob lems - involving, primarily, multibody electro-mechanical systems - in which nonlinearity plays an essential role. Fortunately, the geometric theory of non linear control system analysis progressed substantially during the 1980s and 90s, providing crucial conceptual tools that addressed many of our needs. However, as any control systems engineer can attest, issues of modeling, computation, and implementation quickly become the dominant concerns in practice. The prob lems of interest to us present unique challenges because of the need to build and manipulate complex mathematical models for both the plant and controller. As a result, along with colleagues and students, we set out to develop computer algebra tools to facilitate model building, nonlinear control system design, and code generation, the latter for both numerical simulation and real time con an outgrowth of that continuing effort. As trol implementation. This book is a result, the unique features of the book includes an integrated treatment of nonlinear control and analytical mechanics and a set of symbolic computing software tools for modeling and control system design. By simultaneously considering both mechanics and control we achieve a fuller appreciation of the underlying geometric ideas and constructions that are common to both. Control theory has had a fruitful association with analytical mechanics from its birth in the late 19th century.

Methods of Qualitative Theory in Nonlinear Dynamics

Proceedings of the 34th IMAC, A Conference and Exposition on Structural Dynamics 2016

Analysis and Design of Nonlinear Systems in the Frequency Domain

Recent Trends in Chaotic, Nonlinear and Complex Dynamics

Research in Interactive Design (Vol. 4)

The book covers the fundamentals of the mechanics of multibody systems, i.e., systems of interconnected rigid bodies. A geometric view is emphasized in which the techniques and algorithms are motivated by the picture of the rigid body system as a point in the multidimensional space of all possible configurations. The reader is introduced to computer algebra methods in the form of a system, called Sophia, which is implemented in the Maple symbolic manipulation system. The first chapter provides a motivational introduction to the basic principles and an introduction to Maple. Kinematics based on the idea of tangent vectors to the configuration manifold sets the stage for dynamical analysis. The latter ranges from the Lagrange and Gibbs-Appell to Kane's equations. Coverage includes nonholonomic systems and redundant variable methods. The computer algebra methods included enable the treatment of nontrivial mechanical systems and the development of efficient numerical codes for simulation.

Covering key topics in the field such as technological innovation, human-centered sustainable engineering and manufacturing, and manufacture at a global scale in a virtual world, this book addresses both advanced techniques and industrial applications of key research in interactive design and manufacturing. Featuring the full papers presented at the 2014 Joint Conference on Mechanical Design Engineering and Advanced Manufacturing, which took place in June 2014 in Toulouse, France, it presents recent research and industrial success stories related to implementing interactive design and manufacturing solutions.

The book first introduces the concept of nonlinear normal modes (NNMs) and their two main definitions. The fundamental differences between classical linear normal modes (LNMs) and NNMs are explained and illustrated using simple examples. Different methods for computing NNMs from a mathematical model are presented. Both advanced analytical and numerical methods are described. Particular attention is devoted to the invariant manifold and normal form theories. The book also discusses nonlinear system identification.

Chaos and nonlinear dynamics initially developed as a new emergent field with its foundation in physics and applied mathematics. The highly generic, interdisciplinary quality of the insights gained in the last few decades has spawned myriad applications in almost all branches of science and technology—and even well beyond. Wherever quantitative modeling and analysis of complex, nonlinear phenomena is required, chaos theory and its methods can play a key role. his fourth volume concentrates on reviewing further relevant contemporary applications of chaotic and nonlinear dynamics as they apply to the various cuttingedge branches of science and engineering. This encompasses, but is not limited to, topics such as synchronization in complex networks and chaotic circuits, time series analysis, ecological and biological patterns, stochastic control theory and vibrations in mechanical systems. Featuring contributions from active and leading research groups, this collection is ideal both as a reference and as a ' recipe book ' full of tried and tested, successful engineering applications.

Applications of Chaos and Nonlinear Dynamics in Science and Engineering -

Linear and Nonlinear Instabilities in Mechanical Systems

Bifurcation and Chaos in Nonsmooth Mechanical Systems

Propagation of Waves in Shear Flows

The Analysis of Complex Nonlinear Mechanical Systems

Dynamics and Bifurcations of Non-Smooth Mechanical Systems

Development of new sensors and digital processors has provided opportunity for identification of nonlinear systems. Vibration measurements have become standard for predicting and monitoring machinery in industry. Parameter Identification and Monitoring of Mechanical Systems under Nonlinear Vibration focusses on methods for the identification of nonlinearities in mechanical systems, giving description and examples of practical application. Chapters cover nonlinear dynamics; nonlinear vibrations; signal processing; parameter identification; application of signal processing to mechanical systems; practical experience and industrial applications; and synchronization of nonlinear systems. Covers the most recent advances in machinery monitoring Describes the basis for nonlinear dynamics Presents advantages of applying modern signal processing to mechanical systems

This book features selected manuscripts presented at ICoNSoM 2019, exploring cutting-edge methods for developing novel models in nonlinear solid mechanics. Innovative methods like additive manufacturing—for example, 3D printing— and miniaturization mean that engineers need more accurate techniques for modeling solid body mechanics. The book focuses on the formulation of continuum and discrete models for complex materials and systems, particularly the design of metamaterials.

With many areas of science reaching across their boundaries and becoming more and more interdisciplinary, students and researchers in these fields are confronted with techniques and tools not covered by their particular education. Especially in the life- and neurosciences quantitative models based on nonlinear dynamics and complex systems are becoming as frequently implemented as traditional statistical analysis. Unfamiliarity with the terminology and rigorous mathematics may discourage many scientists to adopt these methods for their own work, even though such reluctance in most cases is not justified. This book bridges this gap by introducing the procedures and methods used for analyzing nonlinear dynamical systems. In Part I, the concepts of fixed points, phase space, stability and transitions, among others, are discussed in great detail and implemented on the basis of example elementary systems. Part II is devoted to specific, non-trivial applications: coordination of human limb movement (Haken-Kelso-Bunz model), self-organization and pattern formation in complex systems (Synergetics), and models of dynamical properties of neurons (Hodgkin-Huxley, Fitzhugh-Nagumo and Hindmarsh-Rose). Part III may serve as a refresher and companion of some mathematical basics that have been forgotten or were not covered in basic math courses. Finally, the appendix contains an explicit derivation and basic numerical methods together with some programming examples as well as solutions to the exercises provided at the end of certain chapters. Throughout this book all derivations are as detailed and explicit as possible, and everybody with some knowledge of calculus should be able to extract meaningful guidance follow and apply the methods of nonlinear dynamics to their own work. " This book is a masterful treatment, one might even say a gift, to the interdisciplinary scientist of the future. " " With the authoritative voice of a genuine practitioner, Fuchs is a master teacher of how to handle complex dynamical systems. " " What I find beautiful in this book is its clarity, the clear definition of terms, every step explained simply and systematically. " (J.A.Scott Kelso, excerpts from the foreword)

Nonlinear Dynamics, Volume 1. Proceedings of the 34th IMAC, A Conference and Exposition on Dynamics of Multiphysical Systems: From Active Materials to Vibroacoustics, 2016, the fi rst volume of ten from the Conference, brings together contributions to this important area of research and engineering. Th e collection presents early fi ndings and case studies on fundamental and applied aspects of Structural Dynamics, including papers on: • Nonlinear Oscillations • Nonlinear Modal Analysis • Nonlinear System Identifi cation • Nonlinear Modeling & Simulation • Nonlinearity in Practice • Nonlinearity in Multi-Physics Systems • Nonlinear Modes and Modal Interactions

A Computer Algebra Assisted Approach

Nonlinear Structural Dynamics and Damping

Models and Experiments : Appearance Routes and Structure of Chaos in Simple Dynamical Systems

Nonlinear Control and Analytical Mechanics

Nonlinear Dynamics in Particle Accelerators

Modal Analysis of Nonlinear Mechanical Systems

This book covers different topics of nonlinear mechanics in complex structures, such as the appearance of new nonlinear phenomena and the behavior of finite-dimensional and distributed nonlinear systems, including numerous systems directly connected with important technological problems.

This book focuses on the development of three novel approaches to build up a framework for the frequency domain analysis and design of nonlinear systems. The concepts are derived from Volterra series representation of nonlinear systems which are described by nonlinear difference or differential equations. Occupying the middle ground between traditional linear approaches and more complex nonlinear system theories, the book will help readers to have a good start to analyse and exploit the nonlinearities. Analysis and Design of Nonlinear Systems in the Frequency Domain provides clear illustrations and examples at the beginning and the end of each chapter, respectively, making it of interest to both academics and practicing engineers.

The state of the art in a theory of oscillatory and wave phenomena in hydrodynamical flows is presented in this book. A unified approach is used for waves of different physical origins. A characteristic feature of this approach is that hydrodynamical phenomena are considered in terms of physics; that is, the complement of the conventionally employed formal mathematical approach. Some physical concepts such as wave energy and momentum in a moving fluid are analysed, taking into account induced mean flow. The physical mechanisms responsible for hydrodynamic instability of shear flows are considered within the concept of negative energy waves. The phenomenon of over-reflection is analysed. A number of well-known theorems of the hydrodynamic theory of stability are interpreted in terms of the interaction of the waves having different energy signs. Attention is drawn to the plasma-hydrodynamic analogy, which is a powerful tool for physical analyses of general mechanisms of wave amplification and absorption in flows. Various wave-flow interaction problems are considered, for instance, sound generation in whistlers, wave scattering and amplification by vortices, methods of wave remote sounding, and some nonlinear dynamical and chaotic phenomena. The book is intended for researchers specializing in wave theory, aeroacoustics, geophysical and astrophysical fluid dynamics, and related fields. It may also be useful to graduate and post-graduate students as a supplement to standard lecture courses. Contents:Wave Energy and Momentum in a Moving MediumWave Generation by Unstable Shear FlowsPiecewise-Linear Models of FlowsOver-ReflectionResonant Wave-Flow InteractionOscillatory Systems with Hydrodynamic FlowsWaves on Concentrated VorticesRemote Wave Sensing of Moving VorticesBibliography Readership: Nonlinear scientists, researchers in wave theory, fluid dynamics and related fields. keywords:Stratified Shear Flows;Hydrodynamic Instabilities;Wave Energy and Momentum;Negative Energy Waves;Wave-Current Interaction. Over-Reflection;Plasma-Hydrodynamic Analogy;Wind Waves;Solitons;Concentrated Vortices;Resonance Interaction;Critical Layer;Whistle;Vortex Sheet;Rossby Waves;Internal Gravity Waves;Sound Scattering;Aerodynamic Generation of Sound "... will be most useful as a reference ... it is well written and substantially free of typographic mistakes." Applied Mechanics Reviews

In this book, bifurcational mechanisms of the development, structure and properties of chaotic attractors are investigated by numerical and physical experiments based on the methods of the modern theory of nonlinear oscillations. The typical bifurcations of regular and chaotic attractors which are due to parameter variations are analyzed.Regularities of the transition to chaos via the collapse of quasiperiodic oscillations with two and three frequencies are investigated in detail. The book deals with the problems of chaotic synchronization, interaction of attractors and the phenomenon of stochastic resonance. The problems of fluctuation influence on the bifurcations and properties of chaotic attractors are investigated more closely.All principal problems are investigated by the comparison of theoretical and numerical results and data from physical experiments.

Linear and Nonlinear Structural Mechanics

NUREG/CR.

Nonlinear Dynamics in Complex Systems

From Order to Chaos II

Visions of Nonlinear Science in the 21st Century

Analysis, Control and Application

This monograph combines the knowledge of both the field of nonlinear dynamics and non-smooth mechanics, presenting a framework for a class of non-smooth mechanical systems using techniques from both fields. The book reviews recent developments, and opens the field to the nonlinear dynamics community. This book addresses researchers and graduate students in engineering and mathematics interested in the modelling, simulation and dynamics of non-smooth systems and nonlinear dynamics.

This book presents the theoretical frame for studying lumped nonsmooth dynamical systems: the mathematical methods are recalled, and adapted numerical methods are introduced (differential inclusions, maximal monotone operators, Filippov theory, Aizerman theory, etc.). Tools available for the analysis of classical smooth nonlinear dynamics (stability analysis, the Melnikov method, bifurcation scenarios, numerical integrators, solvers, etc.) are extended to the nonsmooth frame. Many models and applications arising from mechanical engineering, electrical circuits, material behavior and civil engineering are investigated to illustrate theoretical and computational developments.