

Nonlinear Systems and Complexity
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Complex Motions and Chaos in Nonlinear Systems

 Springer

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Nonlinear Systems And Complexity

**Valentin Afraimovich, José António
Tenreiro Machado, Jiazhong Zhang**



Complex Motions And Chaos In Nonlinear Systems Nonlinear Systems And Complexity:

Complex Motions and Chaos in Nonlinear Systems Valentin Afraimovich, José António Tenreiro Machado, Jiazhong Zhang, 2016-04-22 This book brings together 12 chapters on a new stream of research examining complex phenomena in nonlinear systems including engineering physics and social science Complex Motions and Chaos in Nonlinear Systems provides readers a particular vantage of the nature and nonlinear phenomena in nonlinear dynamics that can develop the corresponding mathematical theory and apply nonlinear design to practical engineering as well as the study of other complex phenomena including those investigated within social science *New Digital Signal Processing Methods* Raoul R. Nigmatullin, Paolo Lino, Guido Maione, 2020-05-23 This book is intended as a manual on modern advanced statistical methods for signal processing The objectives of signal processing are the analysis synthesis and modification of signals measured from different natural phenomena including engineering applications as well Often the measured signals are affected by noise distortion and incompleteness and this makes it difficult to extract significant signal information The main topic of the book is the extraction of significant information from measured data with the aim of reducing the data size while keeping the basic information knowledge about the peculiarities and properties of the analyzed system to this aim advanced and recently developed methods in signal analysis and treatment are introduced and described in depth More in details the book covers the following new advanced topics and the corresponding algorithms including detailed descriptions and discussions the Eigen Coordinates ECs method The statistics of the fractional moments The quantitative universal label QUL and the universal distribution function for the relative fluctuations UDFRF the generalized Prony spectrum the Non orthogonal Amplitude Frequency Analysis of the Smoothed Signals NAFASS the discrete geometrical invariants DGI serving as the common platform for quantitative comparison of different random functions Although advanced topics are discussed in signal analysis each subject is introduced gradually with the use of only the necessary mathematics and avoiding unnecessary abstractions Each chapter presents testing and verification examples on real data for each proposed method In comparison with other books here it is adopted a more practical approach with numerous real case studies Dynamics with Chaos and Fractals Marat Akhmet, Mehmet Onur Fen, Ejaily Milad Alejaily, 2020-01-01 The book is concerned with the concepts of chaos and fractals which are within the scopes of dynamical systems geometry measure theory topology and numerical analysis during the last several decades It is revealed that a special kind of Poisson stable point which we call an unpredictable point gives rise to the existence of chaos in the quasi minimal set This is the first time in the literature that the description of chaos is initiated from a single motion Chaos is now placed on the line of oscillations and therefore it is a subject of study in the framework of the theories of dynamical systems and differential equations as in this book The techniques introduced in the book make it possible to develop continuous and discrete dynamics which admit fractals as points of trajectories as well as orbits themselves To provide strong arguments for the genericity of chaos in the real and abstract universe the concept of

abstract similarity is suggested **Bifurcation Dynamics of a Damped Parametric Pendulum** Yu Guo,Albert C.J. Luo,2022-06-01 The inherent complex dynamics of a parametrically excited pendulum is of great interest in nonlinear dynamics which can help one better understand the complex world Even though the parametrically excited pendulum is one of the simplest nonlinear systems until now complex motions in such a parametric pendulum cannot be achieved In this book the bifurcation dynamics of periodic motions to chaos in a damped parametrically excited pendulum is discussed Complete bifurcation trees of periodic motions to chaos in the parametrically excited pendulum include period 1 motion static equilibriums to chaos and period motions to chaos 1 2 6 8 12 The aforesaid bifurcation trees of periodic motions to chaos coexist in the same parameter ranges which are very difficult to determine through traditional analysis Harmonic frequency amplitude characteristics of such bifurcation trees are also presented to show motion complexity and nonlinearity in such a parametrically excited pendulum system The non travelable and travelable periodic motions on the bifurcation trees are discovered Through the bifurcation trees of travelable and non travelable periodic motions the travelable and non travelable chaos in the parametrically excited pendulum can be achieved Based on the traditional analysis one cannot achieve the adequate solutions presented herein for periodic motions to chaos in the parametrically excited pendulum The results in this book may cause one rethinking how to determine motion complexity in nonlinear dynamical systems The Nonlinear World Yoshitsugu Oono,2012-10-30 The most important characteristic of the world filled with nonlinearity is the existence of scale interference disparate space time scales interfere with each other Thus the effects of unknowable scales invade the world that we can observe directly This leads to various peculiar phenomena such as chaos critical phenomena and complex biological phenomena among others Conceptual analysis and phenomenology are the keys to describe and understand phenomena that are subject to scale interference because precise description of unfamiliar phenomena requires precise concepts and their phenomenological description The book starts with an illustration of conceptual analysis in terms of chaos and randomness and goes on to explain renormalization group philosophy as an approach to phenomenology Then abduction is outlined as a way to express what we have understood about the world The book concludes with discussions on how we can approach genuinely complex phenomena including biological phenomena The main target of this volume is young people who have just started to appreciate the world seriously The author also wishes the book to be helpful to those who have been observing the world but who wish to appreciate it afresh from a different angle Periodic Motions to Chaos in a Spring-Pendulum System Yu Guo,Albert C. J. Luo,2023-02-06 This book builds on the fundamental understandings learned in undergraduate engineering and physics in principles of dynamics and control of mechanical systems The design of real world mechanical systems and devices becomes far more complex than the spring pendulum system to which most engineers have been exposed The authors provide one of the simplest models of nonlinear dynamical systems for learning complex nonlinear dynamical systems The book addresses the complex challenges of the necessary modeling for the design of machines The

book addresses the methods to create a mechanical system with stable and unstable motions in environments influenced by an array of motion complexity including varied excitation frequencies ranging from periodic motions to chaos Periodic motions to chaos in a periodically forced nonlinear spring pendulum system are presented through the discrete mapping method and the corresponding stability and bifurcations of periodic motions on the bifurcation trees are presented Developed semi analytical solutions of periodical motions to chaos help the reader to understand complex nonlinear dynamical behaviors in nonlinear dynamical systems Especially one can use unstable motions rather than stable motions only Discretization and Implicit Mapping Dynamics Albert C. J. Luo,2015-07-30 This unique book presents the discretization of continuous systems and implicit mapping dynamics of periodic motions to chaos in continuous nonlinear systems The stability and bifurcation theory of fixed points in discrete nonlinear dynamical systems is reviewed and the explicit and implicit maps of continuous dynamical systems are developed through the single step and multi step discretizations The implicit dynamics of period m solutions in discrete nonlinear systems are discussed The book also offers a generalized approach to finding analytical and numerical solutions of stable and unstable periodic flows to chaos in nonlinear systems with without time delay The bifurcation trees of periodic motions to chaos in the Duffing oscillator are shown as a sample problem while the discrete Fourier series of periodic motions and chaos are also presented The book offers a valuable resource for university students professors researchers and engineers in the fields of applied mathematics physics mechanics control systems and engineering Nonlinear Vibration Reduction Albert C. J. Luo,Chuan Guo,2022-11-30 The tuned mass damper is one of the classic dynamic vibration absorbers with effective devices for energy dissipation and vibration reduction The electromagnetically tuned mass damper system is extensively used for vibration reduction in engineering A better understanding of the nonlinear dynamics of the electromagnetically tuned mass damper system is very important to optimize the parameters of such systems for vibration reduction However until now one cannot fully understand complex periodic motions in such a nonlinear electromagnetically tuned mass damper system In this book the semi analytical solutions of periodic motions are presented through period 1 period 3 period 9 and period 12 motions The corresponding stability and bifurcations of periodic motions are determined The frequency amplitude characteristics for bifurcation routes of such higher order periodic motions are presented This book helps people better understand the dynamical behaviors of an electromagnetically tuned mass damper system for the new development and design of vibration reduction and energy harvesting systems Discrete Dynamical Systems, Bifurcations and Chaos in Economics Wei-Bin Zhang,2006-01-05 This book is a unique blend of difference equations theory and its exciting applications to economics It deals with not only theory of linear and linearized difference equations but also nonlinear dynamical systems which have been widely applied to economic analysis in recent years It studies most important concepts and theorems in difference equations theory in a way that can be understood by anyone who has basic knowledge of calculus and linear algebra It contains well known

applications and many recent developments in different fields of economics The book also simulates many models to illustrate paths of economic dynamics A unique book concentrated on theory of discrete dynamical systems and its traditional as well as advanced applications to economics Mathematical definitions and theorems are introduced in a systematic and easily accessible way Examples are from almost all fields of economics technically proceeding from basic to advanced topics Lively illustrations with numerous figures Numerous simulation to see paths of economic dynamics Comprehensive treatment of the subject with a comprehensive and easily accessible approach

Chaos and Society A. Albert, 1995 This publication reflects on the discussion on using chaos theory for the study of society It explores the interface between chaos theory and the social sciences A broad variety of fields including Sociology Anthropology Economics Political Science Management Philosophy and Cognitive Sciences is represented in the book The leading themes are Conceptual and Methodological Issues Social Connectionism and the Connectionist Mind Social Institutions and Public Policy and Social Simulations The book includes the following topics the relevance of the complexity chaos paradigm for analyzing social systems the usefulness of nonlinear dynamics for studying the formation and sustainability of social groups the comparison between spontaneous social orders and spontaneous biological natural orders the building of Artificial Societies and the contribution of the chaos paradigm to a better understanding and formulation of public policies

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