

UNDERSTANDING
COMPLEX SYSTEMS

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COMPLEXITY

Vladimir G. Ivancevic
Tijana T. Ivancevic

Complex Nonlinearity

Chaos, Phase Transitions,
Topology Change and Path Integrals



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Complex Nonlinearity Complex Nonlinearity

Danilo P. Mandic, Vanessa Su Lee Goh



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Complex Nonlinearity Vladimir G. Ivancevic, Tijana T. Ivancevic, 2008-05-31 Complex Nonlinearity Chaos Phase Transitions Topology Change and Path Integrals is a book about prediction control of general nonlinear and chaotic dynamics of high dimensional complex systems of various physical and non physical nature and their underpinning geometro topological change The book starts with a textbook like expose on nonlinear dynamics attractors and chaos both temporal and spatio temporal including modern techniques of chaos control Chapter 2 turns to the edge of chaos in the form of phase transitions equilibrium and non equilibrium oscillatory fractal and noise induced as well as the related field of synergetics While the natural stage for linear dynamics comprises of flat Euclidean geometry with the corresponding calculation tools from linear algebra and analysis the natural stage for nonlinear dynamics is curved Riemannian geometry with the corresponding tools from nonlinear tensor algebra and analysis The extreme nonlinearity chaos corresponds to the topology change of this curved geometrical stage usually called configuration manifold Chapter 3 elaborates on geometry and topology change in relation with complex nonlinearity and chaos Chapter 4 develops general nonlinear dynamics continuous and discrete deterministic and stochastic in the unique form of path integrals and their action amplitude formalism This most natural framework for representing both phase transitions and topology change starts with Feynman s sum over histories to be quickly generalized into the sum over geometries and topologies The last Chapter puts all the previously developed techniques together and presents the unified form of complex nonlinearity Here we have chaos phase transitions geometrical dynamics and topology change all working together in the form of path integrals The objective of this book is to provide a serious reader with a serious scientific tool that will enable them to actually perform a competitive research in modern complex nonlinearity It includes a comprehensive bibliography on the subject and a detailed index Target readership includes all researchers and students of complex nonlinear systems in physics mathematics engineering chemistry biology psychology sociology economics medicine etc working both in industry clinics and academia

Parameter Extraction and Complex Nonlinear Transistor Models Gunter Kompa, 2019-12-31 All model parameters are fundamentally coupled together so that directly measured individual parameters although widely used and accepted may initially only serve as good estimates This comprehensive resource presents all aspects concerning the modeling of semiconductor field effect device parameters based on gallium arsenide GaAs and gallium nitride GaN technology Metal semiconductor field effect transistors MESFETs high electron mobility transistors HEMTs and heterojunction bipolar transistors HBTs their structures and functions and existing transistor models are also classified The Shockley model is presented in order to give insight into semiconductor field effect transistor FET device physics and explain the relationship between geometric and material parameters and device performance Extraction of trapping and thermal time constants is discussed A special section is devoted to standard nonlinear FET models applied to large signal measurements including static pulsed DC and single two tone stimulation High

power measurement setups for signal waveform measurement wideband source load pull measurement including envelope source load pull are also included along with high power intermodulation distortion IMD measurement setup including envelope load pull Written by a world renowned expert in the field this book is the first to cover of all aspects of semiconductor FET device modeling in a single volume *Interdisciplinary Approaches to Nonlinear Complex Systems* Hermann Haken,A. Mikhailov,2012-12-06 Nonlinear dynamics is now recognized as playing a crucial role in a wide variety of disciplines But what is only just beginning is the important process of cross fertilization and transfer of knowledge and expertise from one area to another This book is intended to promote this process which will undoubtedly contribute greatly to furthering our understanding of complex systems Contributions are provided by leading experts from the areas of sociology cognitive science chemistry physiology ecology economics neural networks and physics Complex Valued Nonlinear Adaptive Filters Danilo P. Mandic,Vanessa Su Lee Goh,2009-04-20 This book was written in response to the growing demand for a text that provides a unified treatment of linear and nonlinear complex valued adaptive filters and methods for the processing of general complex signals circular and noncircular It brings together adaptive filtering algorithms for feedforward transversal and feedback architectures and the recent developments in the statistics of complex variable under the powerful frameworks of CR Wirtinger calculus and augmented complex statistics This offers a number of theoretical performance gains which is illustrated on both stochastic gradient algorithms such as the augmented complex least mean square ACLMS and those based on Kalman filters This work is supported by a number of simulations using synthetic and real world data including the noncircular and intermittent radar and wind signals **Localized Excitations in Nonlinear Complex Systems** Ricardo Carretero-González,Jesús Cuevas-Maraver,Dimitri Frantzeskakis,Nikos Karachalios,Panayotis Kevrekidis,Faustino Palmero-Acebedo,2013-11-19 The study of nonlinear localized excitations is a long standing challenge for research in basic and applied science as well as engineering due to their importance in understanding and predicting phenomena arising in nonlinear and complex systems but also due to their potential for the development and design of novel applications This volume is a compilation of chapters representing the current state of the art on the field of localized excitations and their role in the dynamics of complex physical systems **Discontinuity, Nonlinearity, and Complexity** Lev Ostrovsky,Dimitry Volchenkov,2018-07-01 The interdisciplinary journal publishes original and new results on recent developments discoveries and progresses on Discontinuity Nonlinearity and Complexity in physical and social sciences The aim of the journal is to stimulate more research interest for exploration of discontinuity complexity nonlinearity and chaos in complex systems The manuscripts in dynamical systems with nonlinearity and chaos are solicited which includes mathematical theories and methods physical principles and laws and computational techniques The journal provides a place to researchers for the rapid exchange of ideas and techniques in discontinuity complexity nonlinearity and chaos in physical and social sciences No length limitations for contributions are set but only concisely written manuscripts are published Brief

papers are published on the basis of Technical Notes Discussions of previous published papers are welcome Topics of Interest Complex and hybrid dynamical systems Discontinuous dynamical systems i e impulsive time delay flow barriers Nonlinear discrete systems and symbolic dynamics Fractional dynamical systems and control Stochastic dynamical systems and randomness Complexity self similarity and synchronization in nonlinear physics Nonlinear phenomena and physical mechanisms Stability bifurcation and chaos in complex systems Hydrodynamics turbulence and complexity mechanism Nonlinear waves and soliton Dynamical networks Combinatorial aspects of dynamical systems Biological dynamics and biophysics

Stability Regions of Nonlinear Dynamical Systems Hsiao-Dong Chiang, Luís F. C. Alberto, 2015-08-13 This authoritative treatment covers theory optimal estimation and a range of practical applications The first book on the subject and written by leading researchers this clear and rigorous work presents a comprehensive theory for both the stability boundary and the stability regions of a range of nonlinear dynamical systems including continuous discrete complex two time scale and non hyperbolic systems illustrated with numerical examples The authors also propose new concepts of quasi stability region and of relevant stability regions and their complete characterisations Optimal schemes for estimating stability regions of general nonlinear dynamical systems are also covered and finally the authors describe and explain how the theory is applied in applications including direct methods for power system transient stability analysis nonlinear optimisation for finding a set of high quality optimal solutions stabilisation of nonlinear systems ecosystem dynamics and immunisation problems

Strongly Nonlinear Oscillators Livija Cveticanin, 2014-05-22 This book provides the presentation of the motion of pure nonlinear oscillatory systems and various solution procedures which give the approximate solutions of the strong nonlinear oscillator equations The book presents the original author s method for the analytical solution procedure of the pure nonlinear oscillator system After an introduction the physical explanation of the pure nonlinearity and of the pure nonlinear oscillator is given The analytical solution for free and forced vibrations of the one degree of freedom strong nonlinear system with constant and time variable parameter is considered Special attention is given to the one and two mass oscillatory systems with two degrees of freedom The criteria for the deterministic chaos in ideal and non ideal pure nonlinear oscillators are derived analytically The method for suppressing chaos is developed Important problems are discussed in didactic exercises The book is self consistent and suitable as a textbook for students and also for professionals and engineers who apply these techniques to the field of nonlinear oscillations

Quantum Theory from a Nonlinear Perspective Dieter Schuch, 2018-01-20 This book provides a unique survey displaying the power of Riccati equations to describe reversible and irreversible processes in physics and in particular quantum physics Quantum mechanics is supposedly linear invariant under time reversal conserving energy and in contrast to classical theories essentially based on the use of complex quantities However on a macroscopic level processes apparently obey nonlinear irreversible evolution equations and dissipate energy The Riccati equation a nonlinear equation that can be linearized has the potential to link these two worlds

when applied to complex quantities The nonlinearity can provide information about the phase amplitude correlations of the complex quantities that cannot be obtained from the linearized form As revealed in this wide ranging treatment Riccati equations can also be found in many diverse fields of physics from Bose Einstein condensates to cosmology The book will appeal to graduate students and theoretical physicists interested in a consistent mathematical description of physical laws

Control of Self-Organizing Nonlinear Systems Eckehard Schöll, Sabine H. L. Klapp, Philipp Hövel, 2016-01-22 The book summarizes the state of the art of research on control of self organizing nonlinear systems with contributions from leading international experts in the field The first focus concerns recent methodological developments including control of networks and of noisy and time delayed systems As a second focus the book features emerging concepts of application including control of quantum systems soft condensed matter and biological systems Special topics reflecting the active research in the field are the analysis and control of chimera states in classical networks and in quantum systems the mathematical treatment of multiscale systems the control of colloidal and quantum transport the control of epidemics and of neural network dynamics

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