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# NONLINEAR DYNAMICS IN OPTICAL COMPLEX SYSTEMS

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# Nonlinear Dynamics In Optical Complex Systems

**Kunihiko Kaneko, Ichiro Tsuda**



## **Nonlinear Dynamics In Optical Complex Systems:**

Nonlinear Dynamics in Optical Complex Systems Kenju Otsuka, 2000-04-30 This book is the first comprehensive volume on nonlinear dynamics and chaos in optical systems A few books have been published recently but they summarize applied mathematical methodologies toward understanding of nonlinear dynamics in laser systems with small degrees of freedom focusing on linearized perturbation and bifurcation analyses In contrast to these publications this book summarizes nonlinear dynamic problems in optical complex systems possessing large degrees of freedom systematically featuring our original experimental results and their theoretical treatments The new concepts introduced in this book will have a wide appeal to audiences involved in a rapidly growing field of nonlinear dynamics This book focuses on nonlinear dynamics and cooperative functions in realistic optical complex systems such as multimode lasers laser array coupled nonlinear element systems and their applications to optical processing This book is prepared for graduate students majoring in optical and laser physics but the generic nature of complex systems described in this book may stimulate researchers in the field of nonlinear dynamics covering different academic areas including applied mathematics hydrodynamics celestial mechanics chemistry biology and economics

*Advances in Nonlinear Photonics* Giancarlo C. Righini, Luigi Sirleto, 2023-05-03 *Advances in Nonlinear Photonics* combines fundamental principles with an overview of the latest developments The book is suitable for the multidisciplinary audience of photonics researchers and practitioners in academia and R D including materials scientists and engineers applied physicists chemists etc As nonlinear phenomena are at the core of photonic devices and may enable future applications such as all optical switching all optical signal processing and quantum photonics this book provides an overview of key concepts In addition the book reviews the most important advances in the field and how nonlinear processes may be exploited in different photonic applications Introduces fundamental principles of nonlinear phenomena and their application in materials and devices Reviews and provides definitions of the latest research directions in the field of nonlinear photonics Discusses the most important developments in materials and applications including future prospects

*Nonlinear Dynamics and Entropy of Complex Systems with Hidden and Self-excited Attractors* Christos Volos, Sajad Jafari, Jacques Kengne, Jesus M. Munoz-Pacheco, Karthikeyan Rajagopal, 2019-05-03 In recent years entropy has been used as a measure of the degree of chaos in dynamical systems Thus it is important to study entropy in nonlinear systems Moreover there has been increasing interest in the last few years regarding the novel classification of nonlinear dynamical systems including two kinds of attractors self excited attractors and hidden attractors The localization of self excited attractors by applying a standard computational procedure is straightforward In systems with hidden attractors however a specific computational procedure must be developed since equilibrium points do not help in the localization of hidden attractors Some examples of this kind of system are chaotic dynamical systems with no equilibrium points with only stable equilibria curves of equilibria and surfaces of equilibria and with non hyperbolic equilibria There is evidence that hidden attractors play a vital role in various fields

ranging from phase locked loops oscillators describing convective fluid motion drilling systems information theory cryptography and multilevel DC DC converters This Special Issue is a collection of the latest scientific trends on the advanced topics of dynamics entropy fractional order calculus and applications in complex systems with self excited attractors and hidden attractors Laser Dynamics Thomas Erneux, Pierre Glorieux, 2010-04-29 Bridging the gap between laser physics and applied mathematics this book offers a new perspective on laser dynamics Combining fresh treatments of classic problems with up to date research asymptotic techniques appropriate for nonlinear dynamical systems are shown to offer a powerful alternative to numerical simulations The combined analytical and experimental description of dynamical instabilities provides a clear derivation of physical formulae and an evaluation of their significance Starting with the observation of different time scales of an operating laser the book develops approximation techniques to systematically explore their effects Laser dynamical regimes are introduced at different levels of complexity from standard turn on experiments to stiff chaotic spontaneous or driven pulsations Particular attention is given to quantitative comparisons between experiments and theory The book broadens the range of analytical tools available to laser physicists and provides applied mathematicians with problems of practical interest making it invaluable for graduate students and researchers

Semiconductor Lasers Junji Ohtsubo, 2007-10-24 Preface for the second edition Chaos research in laser physics especially in semiconductor lasers has developed further even after completion of the first edition of this book in the late summer of 2004 and it is still growing rapidly For example various forms of chaotic dynamics have been applied in newly developed semiconductor lasers such as in vertical cavity surface emitting semiconductor lasers and broad area semiconductor lasers Chaotic dynamics plays an important role in these new lasers even for their solitary oscillations and control of the dynamics is currently an important issue for practical applications other significant advance has been made in the area of chaotic optical secure communications Chaotic secure communications using existing public optical communications links have been tested and successful results have been obtained In this second edition I have filled in the gaps in the explanation of chaotic laser dynamics in the previous edition and I have also added several important topics that have been developed recently In particular a new chapter on laser stabilizations has been added and a number of misprints in the first edition have been corrected I believe this book will be of interest not only to researchers in the field of laser chaos but also to those working in nonlinear science and technology Hamamatsu Spring 2007 Junji Ohtsubo Preface

The aim of this book is the description of the state of the art of chaos research in semiconductor lasers and their applications and the future perspective of this field **Nonlinear Dynamics and Computational Physics** V. B. Sheorey, 1999 The 24 articles presented in this volume cover emerging areas in nonlinear dynamics They discuss a range of topics from chaotic quantum systems to nonlinear dynamics of the earth's magnetosphere and from microscopic chaos and nonequilibrium statistical mechanics to nonlinear dynamics of human brain activity The articles are written by leading researchers both from India and

other countries It is hoped that the volume will provide information and inspiration and suggest new research directions both to the expert and novice alike

**Progress in Optics** ,2005-10-27 In the thirty seven years that have gone by since the first volume of Progress in Optics was published optics has become one of the most dynamic fields of science At the time of inception of this series the first lasers were only just becoming operational holography was in its infancy subjects such as fiber optics integrated optics and optoelectronics did not exist and quantum optics was the domain of only a few physicists The term photonics had not yet been coined Today these fields are flourishing and have become areas of specialisation for many science and engineering students and numerous research workers and engineers throughout the world Some of the advances in these fields have been recognized by awarding Nobel prizes to seven physicists in the last twenty years The volumes in this series which have appeared up to now contain nearly 190 review articles by distinguished research workers which have become permanent records for many important developments They have helped optical scientists and optical engineers to stay abreast of their fields There is no sign that developments in optics are slowing down or becoming less interesting We confidently expect that just like their predecessors future volumes of Progress in Optics will faithfully record the most important advances that are being made in optics and related fields

#### **Topics In Nonlinear Dynamics:**

**Applications To Physics, Biology And Economic Systems** Erik Mosekilde,1997-01-04 Through a series of examples from physics engineering biology and economics this book illustrates the enormous potential for application of ideas and concepts from nonlinear dynamics and chaos theory The overlap with examples published in other books is virtually equal to zero The book takes the reader from detailed studies of bifurcation structures of relatively simple models to pattern formation in spatially extended systems The book also discusses the different perspectives that nonlinear dynamics brings to different fields of science

**Complex Systems: Chaos and Beyond** Kuniyiko Kaneko,Ichiro Tsuda,2011-06-28 Chaos in science has always been a fascinating realm since it challenges the usual scientific approach of reductionism While carefully distinguishing between complexity holism randomness incompleteness nondeterminism and stochastic behaviour the authors show that although many aspects of chaos have been phenomenologically understood most of its defining principles are still difficult to grasp and formulate Demonstrating that chaos escapes all traditional methods of description the authors set out to find new methods to deal with this phenomenon and illustrate their constructive approach with many examples from physics biology and information technology While maintaining a high level of rigour an overly complicated mathematical apparatus is avoided in order to make this book accessible beyond the specialist level to a wider interdisciplinary readership

**Progress in Optics** Emil Wolf,2002-12-11 Progress in Optics Volume 44

**Frontiers in Guided Wave Optics and Optoelectronics** Bishnu Pal,2010-02-01 As the editor I feel extremely happy to present to the readers such a rich collection of chapters authored co authored by a large number of experts from around the world covering the broad field of guided wave optics and optoelectronics Most of the chapters are state of the art on respective topics or areas that are emerging

Several authors narrated technological challenges in a lucid manner which was possible because of individual expertise of the authors in their own subject specialties I have no doubt that this book will be useful to graduate students teachers researchers and practicing engineers and technologists and that they would love to have it on their book shelves for ready reference at any time

**Handbook of Systems Engineering and Analysis of Electro-Optical and Infrared Systems**

William Wolfgang Arrasmith, 2025-06-30 There has been a lot of innovation in systems engineering and some fundamental advances in the fields of optics imaging lasers and photonics that warrant attention This volume focuses on concepts principles and methods of systems engineering related topics from government industrial and academic settings such as development and operations DevOps agile methods and the concept of the digital twin Handbook of Systems Engineering and Analysis of Electro Optical and Infrared Systems Concepts Principles and Methods offers more information on decision and risk analysis and statistical methods in systems engineering such as design of experiments DOX methods hypothesis testing analysis of variance blocking 2k factorial analysis and regression analysis It includes new material on systems architecture to properly guide the evolving system design and bridge the gap between the requirements generation and design efforts The integration of recent high speed atmospheric turbulence research results in the optical technical examples and case studies to illustrate the new developments is also included A presentation of new optical technical materials on adaptive optics AO atmospheric turbulence compensation ATC and laser systems along with more are also key updates that are emphasized in the second edition 2 volume set Because this volume blends modern day systems engineering methods with detailed optical systems analysis and applies these methodologies to EO IR systems this new edition is an excellent text for professionals in STEM disciplines who work with optical or infrared systems It s also a great practical reference text for practicing engineers and a solid educational text for graduate level systems engineering engineering science and technology students

Nonlinear Dynamics: Materials, Theory and Experiments Mustapha Tlidi, Marcel. G. Clerc, 2015-11-14 This book presents recent advances new ideas and novel techniques related to the field of nonlinear dynamics including localized pattern formation self organization and chaos Various natural systems ranging from nonlinear optics to mechanics fluids and magnetic are considered The aim of this book is to gather specialists from these various fields of research to promote cross fertilization and transfer of knowledge between these active research areas In particular nonlinear optics and laser physics constitute an important part in this issue due to the potential applications for all optical control of light optical storage and information processing Other possible applications include the generation of ultra short pulses using all fiber cavities

Computer Simulation Studies in Condensed-Matter Physics VI David P. Landau, K.K. Mon, Heinz-Bernd

Schüttler, 2012-12-06 Computer Simulation Studies in Condensed Matter Physics VI provides a broad overview of recent developments in this field Based on the last workshop it presents invited and contributed papers which describe new physical results simulational techniques and ways of interpreting simulational data Both classical and quantum systems are discussed

*Computer Simulation Studies in Condensed-Matter Physics V* David P. Landau, K.K. Mon, Heinz-Bernd

Schüttler, 2012-12-06 As the role of computer simulations began to increase in importance we sensed a need for a meeting place for both experienced simulators and neophytes to discuss new techniques and results in an environment which promotes extended discussion. As a consequence of these concerns The Center for Simulation Physics established an annual workshop on Recent Developments in Computer Simulation Studies in Condensed Matter Physics. This year's workshop was the fifth in this series and the interest which the scientific community has shown demonstrates quite clearly the useful purpose which the series has served. The workshop was held at the University of Georgia February 17-21 1992 and these proceedings form a record of the workshop which is published with the goal of timely dissemination of the papers to a wider audience. The proceedings are divided into four parts. The first part contains invited papers which deal with simulation studies of classical systems and includes an introduction to some new simulation techniques and special purpose computers as well. A separate section of the proceedings is devoted to invited papers on quantum systems including new results for strongly correlated electron and quantum spin models. The third section is comprised of a single invited description of a newly developed software shell designed for running parallel programs. The contributed presentations comprise the final chapter.

**Computer Simulation Studies in Condensed-Matter Physics IV** David P. Landau, K.K. Mon, Heinz-Bernd

Schüttler, 2012-12-06 The contribution of computer simulation studies to our understanding of properties of a wide range of condensed matter systems is now well established. The Center for Simulation Physics has been hosting annual workshops with the intent of bringing together some of the experienced practitioners in the field as well as relative newcomers in the field to provide a forum for the exchange of ideas and recent results. This year's workshop, the fourth in the series, was held at the University of Georgia February 18-22 1991. These proceedings are a record of the workshop and are published with the goal of timely dissemination of the papers to a wider audience. The proceedings are divided into three parts. The first part contains invited papers which deal with simulation studies of classical systems and includes an introduction to some new simulation techniques and special purpose computers as well. A separate section of the proceedings is devoted to invited papers on quantum systems including new results for strongly correlated electron and quantum spin models believed to be important for the description of high  $T_c$  superconductors. The contributed presentations comprise the final chapter.

**Cosmic Explosions** J.M. Marcaide, Kurt Weiler, 2005-11-21

Supernovae are among the most energetic phenomena in the Universe and related to almost all aspects of modern astrophysics including starburst galaxies, cosmic ray acceleration, neutron star and black hole formation, nucleosynthesis and ISM chemical enrichment, energy input to the ISM, cosmic distance scale determination, dark energy, related cosmological acceleration, gamma ray bursts, extra solar system neutrino burst detection, gravity wave generation and many more. Additionally, the past 15 years have been particularly productive with many new results and new understanding due in particular to the closest SN in 400 years in SN 1987A in the Large Magellanic Cloud and

the unusually bright and close SN 1993J and SN 1994I in the nearby galaxies M81 and M51 respectively In addition the discovery of the ray burst GRB 980425 and its related supernova SN 1998bw and the confirmation of GRB 030329 SN 2003dh tied the study of SNe and GRBs inextricably together With the many developments since the last joint supernova meeting in La Serena Chile in 1997 we felt that it was an appropriate time to bring together experts and students interested in the subject for a meeting where SN and GRB properties and interrelationships could be discussed The tenth anniversary of SN 1993J provided such an opportunity and appropriately the meeting was held in Spain where SN 1993J was discovered on the early morning of 28 March 1993 by a Spanish amateur astronomer Francisco Garc a

**Computer Simulation Studies in Condensed-Matter Physics XI** David P. Landau, Heinz-Bernd Schüttler, 2012-12-06 More than a decade ago because of the phenomenal growth in the power of computer simulations The University of Georgia formed the first institutional unit devoted to the use of simulations in research and teaching The Center for Simulational Physics As the simulations community expanded further we sensed a need for a meeting place for both experienced simulators and neophytes to discuss new techniques and recent results in an environment which promoted extended discussion As a consequence the Center for Simulational Physics established an annual workshop on Recent Developments in Computer Simulation Studies in Condensed Matter Physics This year's workshop was the eleventh in this series and the interest shown by the scientific community demonstrates quite clearly the useful purpose which the series has served The latest workshop was held at The University of Georgia February 23-27 1998 and these proceedings provide a status report on a number of important topics This volume is published with the goal of timely dissemination of the material to a wider audience We wish to offer a special thanks to IBM Corporation for their generous support of this year's workshop This volume contains both invited papers and contributed presentations on problems in both classical and quantum condensed matter physics We hope that each reader will benefit from specialized results as well as profit from exposure to new algorithms methods of analysis and conceptual developments Athens GA U S A D P Landau April 1998 H B

**Computer Simulation Studies in Condensed-Matter Physics XII** D. P. Landau, S. P. Lewis, H.-B. Schüttler, 2012-12-06 More than a decade ago because of the phenomenal growth in the power of computer simulations The University of Georgia formed the first institutional unit devoted to the use of simulations in research and teaching The Center for Simulational Physics As the simulations community expanded further we sensed a need for a meeting place for both experienced simulators and neophytes to discuss new techniques and recent results in an environment which promoted extended discussion As a consequence the Center for Simulational Physics established an annual workshop on Recent Developments in Computer Simulation Studies in Condensed Matter Physics This year's workshop was the twelfth in this series It was held at The University of Georgia March 8-12 1999 as an unofficial satellite conference to the Centennial Meeting of the American Physical Society in Atlanta GA The continued interest shown by the scientific community demonstrates quite clearly the useful purpose which the series has served These proceedings provide a



status report on a number of important topics This volume is published with the goal of timely dissemination of the material to a wider audience We wish to offer special thanks to IBM Corporation for their generous support of this year's workshop This volume contains both invited papers and contributed presentations on problems in both classical and quantum condensed matter physics We hope that each reader will benefit from specialized results as well as profit from exposure to new algorithms methods of analysis and conceptual developments

Scientific and Technical Aerospace Reports ,1995

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