

Junji Ohtsubo

Semiconductor Lasers

Stability, Instability and Chaos

3rd Edition



Springer

Semiconductor Lasers Stability Instability And Chaos

Junji Ohtsubo



Semiconductor Lasers Stability Instability And Chaos:

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 *Semiconductor Lasers* Junji Ohtsubo, 2012-10-06 This third edition of *Semiconductor Lasers Stability Instability and Chaos* was significantly extended In the previous edition the dynamics and characteristics of chaos in semiconductor lasers after the introduction of the fundamental theory of laser chaos and chaotic dynamics induced by self optical feedback and optical injection was discussed Semiconductor lasers with new device structures such as vertical cavity surface emitting lasers and broad area semiconductor lasers are interesting devices from the viewpoint of chaotic dynamics since they essentially involve chaotic dynamics even in their free running oscillations These topics are also treated with respect to the new developments in the current edition Also the control of such instabilities and chaos control are critical issues for applications Another interesting and important issue of semiconductor laser chaos in this third edition is chaos synchronization between two lasers and the application to optical secure communication One of the new topics in this edition is fast physical number generation using chaotic semiconductor lasers for secure communication and development of chaos chips and their application As other new important topics the recent advance of new semiconductor laser structures is presented such as quantum dot semiconductor lasers quantum cascade semiconductor lasers vertical cavity surface emitting lasers and physical random number generation with application to quantum key distribution Stabilities instabilities and control of quantum dot semiconductor lasers and quantum cascade lasers are important topics in this field

Semiconductor Lasers Junji Ohtsubo, 2010-11-16 This monograph describes fascinating recent progress in the field of chaos stability and instability of semiconductor lasers Applications and future prospects are discussed in detail The book

emphasizes the various dynamics induced in semiconductor lasers by optical and electronic feedback optical injection and injection current modulation Recent results of both theoretical and experimental investigations are presented Demonstrating applications of semiconductor laser chaos control and noise Semiconductor Lasers describes suppression and chaotic secure communications For those who are interested in optics but not familiar with nonlinear systems a brief introduction to chaos analysis is presented *Semiconductor Lasers* Junji Ohtsubo,2008 This monograph describes fascinating recent progress in the field of chaos stability and instability of semiconductor lasers Applications and future prospects are discussed in detail The book emphasizes the various dynamics induced in semiconductor lasers by optical and electronic feedback optical injection and injection current modulation Recent results of both theoretical and experimental investigations are presented Demonstrating applications of semiconductor laser chaos control and noise Semiconductor Lasers describes suppression and chaotic secure communications For those who are interested in optics but not familiar with nonlinear systems a brief introduction to chaos analysis is presented

Theory of Semiconductor Lasers Minoru Yamada,2014-04-10 This book provides a unified and complete theory for semiconductor lasers covering topics ranging from the principles of classical and quantum mechanics to highly advanced levels for readers who need to analyze the complicated operating characteristics generated in the real application of semiconductor lasers The author conducts a theoretical analysis especially on the instabilities involved in the operation of semiconductor lasers A density matrix into the theory for semiconductor lasers is introduced and the formulation of an improved rate equation to help understand the mode competition phenomena which cause the optical external feedback noise is thoroughly described from the basic quantum mechanics The derivation of the improved rate equation will allow readers to extend the analysis for the different types of semiconductor materials and laser structures they deal with This book is intended not only for students and academic researchers but also for engineers who develop lasers for the market as the advanced topics covered are dedicated to real problems in implementing semiconductor lasers for practical use

Oscillations, Waves and Interactions Thomas Kurz,2007

Microcavity Semiconductor Lasers Yong-zhen Huang,Yue-de Yang,2021-05-24 Microcavity Semiconductor Lasers Explore this thorough overview of integrable microcavity semiconductor lasers and their applications from two leading voices in the field Attracting a great deal of attention over the last decades for their promising applications in photonic integration and optical interconnects microcavity semiconductor lasers continue to develop via advances in fundamental physics theoretical analysis and numerical simulations In a new work that will be of interest to researchers and practitioners alike Microcavity Semiconductor Lasers Principles Design and Applications delivers an application oriented and highly relevant exploration of the theory fabrication and applications of these practical devices The book focuses on unidirectional emission microcavity lasers for photonic integrated circuits including polygonal microresonators microdisk and microring lasers After an introductory overview of optical microcavities for microlasers and detailed information of the lasers themselves including mode structure control and

characteristics and lasing properties the distinguished authors discuss fabrication and applications of different microcavity lasers Prospects for future research and potential new applications round out the book Readers will also benefit from the inclusion of A thorough introduction to multilayer optical waveguides the FDTD Method and Pad Approximation and deformed chaos and unidirectional emission microdisk lasers An exploration of mode analysis for triangle and square microresonators similar as FP Cavity Practical discussions of mode analysis and control for deformed square microlasers An examination of hexagonal microcavity lasers and polygonal microcavities along with vertical radiation loss for 3D microcavities Perfect for laser specialists semiconductor physicists and solid state physicists Microcavity Semiconductor Lasers Principles Design and Applications will also earn a place in the libraries of materials scientists and professionals working in the semiconductor and optical industries seeking a one stop reference for integrable microcavity semiconductor lasers

Introduction to Simulations of Semiconductor Lasers Marek Wartak, 2024-03-21 Simulations play an increasingly important role not only in scientific research but also in engineering developments Introduction to Simulations of Semiconductor Lasers introduces senior undergraduates to the design of semiconductor lasers and their simulations The book begins with explaining the physics and fundamental characteristics behind semiconductor lasers and their applications It presumes little prior knowledge such that only a familiarity with the basics of electromagnetism and quantum mechanics is required The book transitions from textbook explanations equations and formulas to ready to run numeric codes that enable the visualization of concepts and simulation studies Multiple chapters are supported by MATLAB code which can be accessed by the students These are ready to run but they can be modified to simulate other structures if desired Providing a unified treatment of the fundamental principles and physics of semiconductors and semiconductor lasers Introduction to Simulations of Semiconductor Lasers is an accessible practical guide for advanced undergraduate students of Physics particularly for courses in laser physics Key Features A unified treatment of fundamental principles Explanations of the fundamental physics of semiconductor Explanations of the operation of semiconductor lasers An historical overview of the subject

Nonlinear and Nonequilibrium Dynamics of Quantum-Dot Optoelectronic Devices Benjamin Lingnau, 2015-12-14 This thesis sheds light on the unique dynamics of optoelectronic devices based on semiconductor quantum dots The complex scattering processes involved in filling the optically active quantum dot states and the presence of charge carrier nonequilibrium conditions are identified as sources for the distinct dynamical behavior of quantum dot based devices Comprehensive theoretical models which allow for an accurate description of such devices are presented and applied to recent experimental observations The low sensitivity of quantum dot lasers to optical perturbations is directly attributed to their unique charge carrier dynamics and amplitude phase coupling which is found not to be accurately described by conventional approaches The potential of quantum dot semiconductor optical amplifiers for novel applications such as simultaneous multi state amplification ultra wide wavelength conversion and coherent pulse shaping is investigated The scattering mechanisms and

the unique electronic structure of semiconductor quantum dots are found to make such devices prime candidates for the implementation of next generation optoelectronic applications which could significantly simplify optical telecommunication networks and open up novel high speed data transmission schemes

Optical Communication with Chaotic Lasers

Atsushi Uchida, 2012-02-13 Starting with an introduction to the fundamental physics in chaotic instabilities in laser systems this comprehensive and unified reference goes on to present the techniques and technology of synchronization of chaos in coupled lasers as well as the many applications to lasers and optics communications security and information technology Throughout it presents the current state of knowledge including encoding decoding techniques performance of chaotic communication systems random number generation and novel communication technologies

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