

# Control of optical chaos spectrum in semiconductor laser for secure RoF communication

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A critical requirement in optical chaos based secure radio over fiber (RoF) system design is the ability to control center frequency, spectral bandwidth, power level and signature of chaos to submerge message with sufficient horizontal and vertical margins both in time and frequency domains. Once frequency domain masking is completely achieved, time domain masking is met automatically, the former being more stringent. In a direct modulated semiconductor laser, the three control parameters are bias current ( $I_{bias}$ ), modulation current ( $I_{mod}$ ) and modulation frequency ( $\omega_m$ ). It is found that  $I_{mod}$  increases bandwidth and amplitude dynamic range of chaotic pulses.  $I_{bias}$  increases the cavity power and hence average peak amplitude of laser chaotic pulses. The modulation frequency increases the speed of overall cavity dynamics and hence is used to increase the bandwidth of chaos but a corresponding increase in bias and modulation currents is required to support high repetition pulses. The results show relationship between three control parameters (bias current, modulation current and modulation frequency) in a direct modulated semiconductor laser and optical chaos bandwidth using regression.

**Keywords:** chaos, radio over fiber, secure optical communication.

## 1. Introduction

Chaos is ubiquitously found in both naturally existing and man-made complex nonlinear systems. The human heart pulsed ECG and human brain pulsed neuron signals are also inherently chaotic, specifically like the spiky or pulsed chaos produced by both semiconductor [1-5] and fiber lasers [6-10]. This fact emphasizes the importance of studying pulsed chaos in time domain, RF and optical spectral domains in this work. The intended application here is secure RoF communication, yet due to rich dynamics studied very systematically, this work may have further applications of interest in related areas. Optical chaos has been studied both numerically and experimentally for three decades in an effort to ensure physical layer security of analog and digital optical communication and EU funded field demonstration in Athens [2] has demonstrated the working of overall concept. Chaos is generated in both continuous nonlinear and dis-

# Selected Papers On Optical Chaos

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**Selected Papers on Optical Chaos** F. T. Arecchi, Robert G. Harrison, 1994 *Topics On Chaotic Systems: Selected Papers From Chaos 2008 International Conference* Christos H Skiadas, Ioannis Dimotikalis, Charilaos Skiadas, 2009-05-13 This volume includes the best papers presented at the CHAOS 2008 International Conference on Chaotic Modeling Simulation and Applications It provides a valuable collection of new ideas methods and techniques in the field of nonlinear dynamics chaos fractals and their applications in general science and in engineering sciences It touches on many fields such as chaos dynamical systems nonlinear systems fractals and chaotic attractors It also covers mechanics hydrofluid dynamics chaos in meteorology and cosmology Hamiltonian and quantum chaos chaos in biology and genetics chaotic control and chaos in economy and markets and chaotic simulations thus containing cutting edge interdisciplinary research with high interest applications These contributions present new solutions by analyzing the relevant data and through the use of recent advances in different fields especially in chaotic simulation methods and techniques **Lasers** Charles Blain, 2002 Developments in lasers continue to enable progress in many areas such as eye surgery the recording industry and dozens of others This book presents citations from the book literature for the last 25 years and groups them for ease of access which is also provided by subject author and titles indexes *Nonlinear Dynamics Of Lasers* F Tito Arecchi, Jean-marc Ginoux, Riccardo Meucci, 2023-02-06 In the early 1980s the late luminary Tito Arecchi was the first to highlight the existence of chaos in a laser model Since then along with several colleagues he developed many important lines of research in this field such as generalized multistability laser with injected signal laser with delayed feedback and the worldwide accepted classification of lasers of A B and C depending on their typical relaxation rates Later chaos control and synchronization were investigated in lasers and other systems providing innovative schemes Very recently in his last contribution to laser physics the model of the laser with feedback demonstrating its universal features was revisited This book aims to present the research activity of Prof Arecchi and his colleagues in the domain of nonlinear dynamics of lasers since his seminal works of 1982 till the latest Also included is our last contribution on jerk dynamics of laser s minimal universal model and a brief history of the discovery of laser where the reader will discover or rediscover many anecdotes about it *Selected Papers on Single-mode Optical Fibers* Alexander Brozeit, R. S. Sirohi, 1994 SPIE Milestones are collections of seminal papers from the world literature covering important discoveries and developments in optics and photonics *Selected Papers on Optical Computing* Henry John Caulfield, Gregory Gheen, 1989 SPIE Milestones are collections of seminal papers from the world literature covering important discoveries and developments in optics and photonics **Chaotic Dynamics** Tamás Tél, Márton Gruiz, 2006-08-24 A clear introduction to chaotic phenomena for undergraduate students in science engineering and mathematics **Selected Papers Of M Ohya** Noboru Watanabe, 2008-02-19 This volume is a collection of articles written by Professor M Ohya over the past three decades in the areas of quantum teleportation quantum information theory

quantum computer etc By compiling Ohya s important works in these areas the book serves as a useful reference for researchers who are working in these fields

**Lasers And Quantum Optics - Proceedings Of The International School** Lorenzo M Narducci,E J Quel,J R Tredicce,1990-04-01 This book is based on a series of lectures given at a Summer School held in Mar del Plata Argentina during the Winter Southamerican of 1988 A number of world renowned researchers have produced comprehensive surveys on topics that range from the basic principles of laser physics and laser dynamics quantum optics quantum aspects of the interaction of a few atoms and the electromagnetic field and other fast growing areas of research This book will be useful for graduate students and young researchers who wish to gain an introduction to the field of modern optics

Selected Papers on Natural Optical Activity Akhlesh Lakhtakia,1990 *Selected Papers on Fiber Optic Sensors* Reinhardt Willsch,Ralf Th Kersten,1995 SPIE Milestones are collections of seminal papers from the world literature covering important discoveries and developments in optics and photonics

*Chaos and Its Reconstruction* Gérard Gouesbet,2003 The editors of the Universite et Institut National des Sciences Appliquees de Rouen France present six chapters exploring the application of chaos theory to such topics as the topological characterisation of attractors and the reconstruction of equations of motion from data Specific topics include the development of a method of modelling called NARMAX non linear autoregressive moving average models with exogenous outputs a summary of the work of the Centre of Applied Dynamics and Optimisation at the U of Western Australia time delayed feedback systems and global modelling applications to biological data and secure communication

**Kokuritsu Kokkai Toshokan shozō kagaku gijutsu kankei Ōbun kaigi roku mokuroku** Kokuritsu Kokkai Toshokan (Japan),1997 **The Cumulative Book Index** ,1999 **Index of Conference Proceedings** British Library. Document Supply Centre,1998 **International Conference on Education in Optics** ,1995

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

*The Pattern Book* Clifford A. Pickover,1995 Although the patterns are computer generated the book is informal and emphasis is on the fun that the true pattern lover finds in doing rather than in reading about the doing

**Water Nexus Approach for Sustainable Development** Keng Yuen Foo,Rajesh Banu,Lai Kuan Lee,Jia Wen,2025-09-25 This book unveils the ground breaking technological advancements in natural environmental protection and pollution treatment encompassing research spanning from the natural environment preservation water pollution control risk assessment policies nexus approach and their related areas According to the October 2023 report by the World Health Organization WHO approximately 10% of the global population continues to consume food irrigated by wastewater

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**Chaotic Oscillations in Mechanical Systems** Tomasz Kapitaniak, 1991

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