



Breather and rogue wave solutions of coupled derivative nonlinear Schrödinger equations

Xiao-Shuo Xiang · Da-Wei Zuo

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Abstract Coupled derivative nonlinear Schrödinger (cDNLS) equations play an important role in plasma physics, optics and other fields. One-order analytical solutions of the cDNLS equations are obtained by virtue of the Darboux transformation. Via adjustment about the parameters, bright-dark conversion mechanism of rogue wave is obtained; combinations of rogue wave and breather/bellshape soliton with different waveform are gotten; distance between rogue wave and breather/bellshape soliton can be changed. In addition, we find that rogue wave has effect on the propagation direction of breather/bellshape soliton.

Keywords Breather and rogue wave solution · Coupled derivative nonlinear Schrödinger equation

1 Introduction

Rogue wave (RW) is a kind of nonlinear wave with wave height more than 2–2.2 times of the initial wave height, which can be seen in the open sea surface but cannot be predicted [1]. RW can be described theoretically by nonlinear evolution equations, and it appears in nonlinear optical systems, water tanks and plasma [2–5]. Periodic RW constitutes breather [6] in which the pulse energy and wave amplitude change periodically

during transmission [7,8]. Breather can be explained by nonlinear evolution equation, while it has also been used to describe the nonlinear Alfvén waves in plasma.

When we discuss the slowly varying waves in the plasma, it is known to us that the following assumptions need to be considered: Wave is quasi-sine and is described by the cold plasma equations; plasma consists of the electrons and one kind of ions; all irreversible effects are neglected; dispersive effects come from the electron inertia and Hall term in the generalized Ohm's law. We will consider the waves which propagate in the x direction and assume all quantities depend on x and t only. Base on the above assumptions, controlled equations can be written as [9]

$$\begin{aligned} \frac{\partial \rho}{\partial t} + \frac{\partial \rho v}{\partial x} &= 0, \\ \frac{\partial \rho v}{\partial x} + \frac{\partial (\rho v^2 + 0.5 B^2)}{\partial x} &= 0, \\ \frac{\partial \tilde{u}}{\partial t} + \frac{v \partial \tilde{u}}{\partial x} &= \frac{\partial \tilde{B}}{\rho \partial x}, \\ \frac{\partial \tilde{B}}{\partial t} + \frac{\partial (v \tilde{B} - \tilde{u})}{\partial x} + i \frac{\partial}{\partial x} \left(\frac{\partial \tilde{B}}{\rho \partial x} \right) \\ &\quad - \alpha \frac{\partial}{\partial x} \left(\frac{\partial}{\partial t} + v \frac{\partial}{\partial x} \right) \frac{\partial \tilde{B}}{\rho \partial x} = 0, \end{aligned} \quad (1)$$

where ρ is the normalized mass density dependent on reality density, v is the normalized fluid velocity in the x direction from $v_A = (\tilde{B}_0^2/4\pi\rho_0)^{1/2}$, while the magnetic field component in the x direction \tilde{B}_0 is a constant by the condition $\nabla \cdot \tilde{B} = 0$. We expand ρ , v , \tilde{u} , \tilde{B} and

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Rogue Equations

Sai Ravela, Adrian Sandu



Rogue Equations:

Rogue Equations, 1999 *New Numerical and Analytical Methods for Nonlinear Partial Differential Equations with Applications in Quantum Physics* Mustafa Inc, Xiao-Jun Yang, Devendra Kumar, 2023-11-20 Various numerical and analytical methods have been used to investigate the models of real world phenomena Namely real world models from quantum physics have been investigated by many researchers This Research Topic aims to promote and exchange new and important theoretical and numerical results to study the dynamics of complex physical systems In particular the Research Topic will focus on numerical and analytical methods for nonlinear partial differential equations which have applications for quantum physical systems Authors are encouraged to introduce their latest original research articles The Research Topic will cover but is not limited to the following themes Mathematical methods in physics Representations of Lie groups in physics Quantum fields Advanced numerical methods and techniques for nonlinear partial differential equations Schrödinger classical and fractional operators Conservation laws

Nonlinear Systems and Their Remarkable Mathematical Structures Norbert Euler, Da-jun Zhang, 2021-09-06 The third volume in this sequence of books consists of a collection of contributions that aims to describe the recent progress in nonlinear differential equations and nonlinear dynamical systems both continuous and discrete Nonlinear Systems and Their Remarkable Mathematical Structures Volume 3 Contributions from China just like the first two volumes consists of contributions by world leading experts in the subject of nonlinear systems but in this instance only featuring contributions by leading Chinese scientists who also work in China in some cases in collaboration with western scientists Features Clearly illustrate the mathematical theories of nonlinear systems and its progress to both the non expert and active researchers in this area Suitable for graduate students in Mathematics Applied Mathematics and some of the Engineering Sciences Written in a careful pedagogical manner by those experts who have been involved in the research themselves and each contribution is reasonably self contained

Asymptotic, Algebraic and Geometric Aspects of Integrable Systems Frank Nijhoff, Yang Shi, Da-jun Zhang, 2020-10-23 This proceedings volume gathers together selected works from the 2018 Asymptotic Algebraic and Geometric Aspects of Integrable Systems workshop that was held at TSIMF Yau Mathematical Sciences Center in Sanya China honoring Nalini Joshi on her 60th birthday The papers cover recent advances in asymptotic algebraic and geometric methods in the study of discrete integrable systems The workshop brought together experts from fields such as asymptotic analysis representation theory and geometry creating a platform to exchange current methods results and novel ideas This volume's articles reflect these exchanges and can be of special interest to a diverse group of researchers and graduate students interested in learning about current results new approaches and trends in mathematical physics in particular those relevant to discrete integrable systems

Peregrine Soliton and Breathers in Wave Physics: Achievements and Perspectives Bertrand Kibler, Amin Chabchoub, Heremba Bailung, 2022-08-16 *Nonlinear Physics: Theory And Experiment II, Proceedings Of The Workshop* Barbara Prinari, M

Boiti,F Pempinelli,Mark J Ablowitz,2003-04-08 The theory of solitons involves a broad variety of mathematical methods and appears in many areas of physics technology biology and pure and applied mathematics In this book emphasis is placed on both theory considering mathematical approaches for classical and quantum nonlinear systems both continuous and discrete and experiment with special discussions on high bit rate optical communications and pulse dynamics in optical materials

Quantum Collisions and Confinement of Atomic and Molecular Species, and Photons P. C. Deshmukh,E.

Krishnakumar,Stephan Fritzsche,M. Krishnamurthy,Sonjoy Majumder,2019-09-28 This book comprises selected peer reviewed papers presented at the 7th Topical Conference of the Indian Society of Atomic and Molecular Physics jointly held at IISER Tirupati and IIT Tirupati India The contributions address current topics of interest in atomic and molecular physics both from the theoretical and experimental perspective The major focus areas include quantum collisions spectroscopy of atomic and molecular clusters photoionization Wigner time delay in collisions laser cooling Bose Einstein condensates atomic clocks quantum computing and trapping and manipulation of quantum systems The book also discusses emerging topics such as ultrafast quantum processes including those at the attosecond time scale This book will prove to be a valuable reference for students and researchers working in the field of atomic and molecular physics *New Approaches to Nonlinear Waves*

Elena Tobisch,2015-08-19 The book details a few of the novel methods developed in the last few years for studying various aspects of nonlinear wave systems The introductory chapter provides a general overview thematically linking the objects described in the book Two chapters are devoted to wave systems possessing resonances with linear frequencies Chapter 2 and with nonlinear frequencies Chapter 3 In the next two chapters modulation instability in the KdV type of equations is studied using rigorous mathematical methods Chapter 4 and its possible connection to freak waves is investigated Chapter 5 The book goes on to demonstrate how the choice of the Hamiltonian Chapter 6 or the Lagrangian Chapter 7 framework allows us to gain a deeper insight into the properties of a specific wave system The final chapter discusses problems encountered when attempting to verify the theoretical predictions using numerical or laboratory experiments All the chapters are illustrated by ample constructive examples demonstrating the applicability of these novel methods and approaches to a wide class of evolutionary dispersive PDEs e g equations from Benjamin Oro Boussinesq Hasegawa Mima KdV type Klein Gordon NLS type Serre Shamel Whitham and Zakharov This makes the book interesting for professionals in the fields of nonlinear physics applied mathematics and fluid mechanics as well as students who are studying these subjects The book can also be used as a basis for a one semester lecture course in applied mathematics or mathematical physics Nonlinear Optical Cavity Dynamics Philippe Grelu,2015-12-14 By recirculating light in a nonlinear propagation medium the nonlinear optical cavity allows for countless options of light transformation and manipulation In passive media optical bistability and frequency conversion are central figures In active media laser light can be generated with versatile underlying dynamics Emphasizing on ultrafast dynamics the vital arena for the information technology the soliton is a common conceptual

keyword thriving into its modern developments with the closely related denominations of dissipative solitons and cavity solitons Recent technological breakthroughs in optical cavities from micro resonators to ultra long fiber cavities have entitled the exploration of nonlinear optical dynamics over unprecedented spatial and temporal orders of magnitude By gathering key contributions by renowned experts this book aims at bridging the gap between recent research topics with a view to foster cross fertilization between research areas and stimulating creative optical engineering design

Mathematical and Numerical Aspects of Wave Propagation WAVES 2003 Gary Cohen,Erkki Heikkola,Patrick Joly,Pekka Neittaanmäki,2012-12-06 This volume includes articles on the mathematical modeling and numerical simulation of various wave phenomena For many years Waves 2003 and its five prior conferences have been an important forum for discussions on wave propagation The topic is equally important for fundamental sciences engineering mathematics and in particular for industrial applications Areas of specific interest are acoustics electromagnetics elasticity and related inverse and optimization problems This book gives an extensive overview of recent developments in a very active field of scientific computing

Applied Mathematical Analysis and Computations I Divine Wanduku,Shijun Zheng,Haomin Zhou,Zhan Chen,Andrew Sills,Ephraim Agyingi,2024-11-09 This volume convenes selected peer reviewed research and survey articles that address the modern state of the art in varied areas of applied mathematical analysis They primarily include presentations as well as invited contributions for the 1st Southern Georgia Mathematics Conference SGMCM that was virtually held on April 2 3 2021 at the Georgia Southern University Statesboro USA Papers in this volume incorporate both advanced theory and methods from mathematical analysis and cover myriad topics like imaging and inverse problems evolutionary PDEs symbolic computation dynamics and data analysis data science computational mathematics and more This first volume focuses on mathematical analysis theory and applications These studies and findings contained herein will be of interest to researchers and graduate students working in the fields of mathematical analysis modeling data analysis and computation with applications in many interdisciplinary applied sciences as in statistics physics biology and medical imaging They are particularly relevant to those at the forefront of applied mathematical and statistical analysis as well as data science and other computational science disciplines In its first edition the Southern Georgia Mathematics Conference brought together 74 speakers from 70 different institutions from the USA Canada Austria and Botswana Attendees included faculty researchers experts graduate and undergraduate students from all over the world

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 Recent Trends in Applied Nonlinear Mechanics and Physics Mohamed Belhaq, 2017-11-13 This book presents contributions on the most active lines of recent advanced research in the field of nonlinear mechanics and physics selected from the 4th International Conference on Structural Nonlinear Dynamics and Diagnosis It includes fifteen chapters by outstanding scientists covering various aspects of applications including road tanker dynamics and stability simulation of abrasive wear energy harvesting modeling and analysis of flexoelectric nanoactuator periodic Fermi Pasta Ulam problems nonlinear stability in Hamiltonian systems nonlinear dynamics of rotating composites nonlinear vibrations of a shallow arch extreme pulse dynamics in mode locked lasers localized structures in a photonic crystal fiber resonator nonlinear stochastic dynamics linearization of nonlinear resonances treatment of a linear delay differential equation and fractional nonlinear damping It appeals to a wide range of experts in the field of structural nonlinear dynamics and offers researchers and engineers an introduction to the challenges posed by nonlinearities in the development of these topics Mathematics Applied to Engineering, Modelling, and Social Issues Frank T. Smith, Hemen Dutta, John N. Mordeson, 2019-03-14 This book presents several aspects of research on mathematics that have significant applications in engineering modelling and social matters discussing a number of current and future social issues and problems in which mathematical tools can be beneficial Each chapter enhances our understanding of the research problems in a particular area of study and highlights the latest advances made in that area The self contained contributions make the results and problems discussed accessible to readers and provides references to enable those interested to follow subsequent studies in still developing fields Presenting real world applications the book is a valuable resource for graduate students researchers and educators It appeals to general readers curious about the practical applications of mathematics in diverse scientific areas and social problems **Giant Waves** Raina Mooncrest, AI, 2025-03-10 Giant Waves explores the science behind rogue waves those unexpectedly massive ocean waves once dismissed as maritime myths It investigates how these waves form the significant dangers they pose to maritime safety and infrastructure and the technological advancements used to detect and predict them The book reveals that rogue waves often several times larger than surrounding waves can appear suddenly and with immense force posing a significant threat to ships and offshore structures The book examines historical accounts and survivor stories alongside scientific data emphasizing the need for a multidisciplinary approach encompassing oceanography meteorology and engineering to understand these extreme events It highlights how increased global shipping and offshore energy exploration amplify the urgency of understanding and mitigating the risks associated with rogue waves For example the book discusses how constructive interference wave current

interaction and nonlinear effects can contribute to the formation of these ocean giants The book progresses logically starting with basic ocean wave theory and moving through mechanisms of rogue wave formation case studies and current research efforts involving satellite altimetry and buoy networks It concludes with practical steps to improve maritime safety and infrastructure resilience offering valuable insights for students researchers maritime professionals and anyone interested in the science of extreme ocean events *Applications of Differential Equations in Engineering and Mechanics* Kam Tim

Chau,2019-01-08 This second of two comprehensive reference texts on differential equations continues coverage of the essential material students they are likely to encounter in solving engineering and mechanics problems across the field alongside a preliminary volume on theory This book covers a very broad range of problems including beams and columns plates shells structural dynamics catenary and cable suspension bridge nonlinear buckling transports and waves in fluids geophysical fluid flows nonlinear waves and solitons Maxwell equations Schrodinger equations celestial mechanics and fracture mechanics and dynamics The focus is on the mathematical technique for solving the differential equations involved All readers who are concerned with and interested in engineering mechanics problems climate change and nanotechnology will find topics covered in this book providing valuable information and mathematics background for their multi disciplinary research and education **Algebra I Essentials For Dummies** Mary Jane Sterling,2019-04-17 Algebra I Essentials For Dummies 9781119590965 was previously published as Algebra I Essentials For Dummies 9780470618349 While this version features a new Dummies cover and design the content is the same as the prior release and should not be considered a new or updated product With its use of multiple variables functions and formulas algebra can be confusing and overwhelming to learn and easy to forget Perfect for students who need to review or reference critical concepts Algebra I Essentials For Dummies provides content focused on key topics only with discrete explanations of critical concepts taught in a typical Algebra I course from functions and FOILs to quadratic and linear equations This guide is also a perfect reference for parents who need to review critical algebra concepts as they help students with homework assignments as well as for adult learners headed back into the classroom who just need a refresher of the core concepts The Essentials For Dummies Series Dummies is proud to present our new series The Essentials For Dummies Now students who are prepping for exams preparing to study new material or who just need a refresher can have a concise easy to understand review guide that covers an entire course by concentrating solely on the most important concepts From algebra and chemistry to grammar and Spanish our expert authors focus on the skills students most need to succeed in a subject Analytical Approach in Nonlinear Dispersive Media Emmanuel Kengne,Wu-Ming Liu,2025-08-30 This book presents an analytical approach to treating several topics of current interest in the field of nonlinear partial differential equations and their applications to electrical and communications engineering the physics of nonlinear dispersive media as well as the nonlinear wave interactions It treats analytically Ginzburg Landau and wave equations such as higher order nonlinear Schrodinger equations with without dissipative terms

Gross Pitaevskii equations with complicated potential terms and cubic quintic Ginzburg Landau equations For solving analytically various problems of mathematical physics in nonlinear dispersive media the book explanatorily and carefully applies several powerful methods drawn from recent leading research articles Special attentions are paid to the modulational instability phenomenon and baseband modulational instability phenomenon in nonlinear dispersive media The theoretical results of this book are supplemented by numerical calculations and graphical illustrations This book is intended for scientific researchers working in the field of nonlinear waves it will be particularly useful for applied mathematicians theoretical physicists as well as electrical and communications engineers *Algebra I For Dummies* Mary Jane Sterling, 2016-05-26

Algebra I For Dummies 2nd Edition 9781119293576 was previously published as *Algebra I For Dummies* 2nd Edition 9780470559642 While this version features a new Dummies cover and design the content is the same as the prior release and should not be considered a new or updated product Factor fearlessly conquer the quadratic formula and solve linear equations There s no doubt that algebra can be easy to some while extremely challenging to others If you re vexed by variables *Algebra I For Dummies* 2nd Edition provides the plain English easy to follow guidance you need to get the right solution every time Now with 25% new and revised content this easy to understand reference not only explains algebra in terms you can understand but it also gives you the necessary tools to solve complex problems with confidence You ll understand how to factor fearlessly conquer the quadratic formula and solve linear equations Includes revised and updated examples and practice problems Provides explanations and practical examples that mirror today s teaching methods Other titles by Sterling *Algebra II For Dummies* and *Algebra Workbook For Dummies* Whether you re currently enrolled in a high school or college algebra course or are just looking to brush up your skills *Algebra I For Dummies* 2nd Edition gives you friendly and comprehensible guidance on this often difficult to grasp subject **Dynamic Data-Driven Environmental**

Systems Science Sai Ravela, Adrian Sandu, 2015-11-26 This book constitutes the refereed proceedings of the First International Conference on Dynamic Data Driven Environmental Systems Science DyDESS 2014 held in Cambridge MA USA in November 2014 The 24 revised full papers and 7 short papers were carefully reviewed and selected from 62 submissions and cover topics on sensing imaging and retrieval for the oceans atmosphere space land earth and planets that is informed by the environmental context algorithms for modeling and simulation downscaling model reduction data assimilation uncertainty quantification and statistical learning methodologies for planning and control sampling and adaptive observation and efficient coupling of these algorithms into information gathering and observing system designs and applications of methodology to environmental estimation analysis and prediction including climate natural hazards oceans cryosphere atmosphere land space earth and planets

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