



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

Emmanuel Kengne, Wu-Ming Liu



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 **Mathematical and Numerical**

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of applied mathematical analysis They primarily include presentations as well as invited contributions for the 1st Southern Georgia Mathematics Conference SGMC 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

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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 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 **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

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web when enough condensed water forms it flows back into the solution when this cooler water hits the bulk hot water it cools it down figure 2 2 2 2 2 c the solubility goes down and crystals form in a ring on the surface of the test tube at

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solids that dissolve in liquids are soluble those that do not dissolve are insoluble

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