Nonlinear Waves

Distributional Nonlinear Wave EquationsSpace-Time Algebra of SedeonsPartial Dynamic EquationsOrdinary Differential EquationsRegularity and Scattering of Dispersive Wave EquationsSolitonsNon-Newtonian FluidsAttractors and MethodsAttractors and Inertial ManifoldsXian Xing Yu Fei Xian Xing BoA Course on Nonlinear WavesNonlinear Waves in Elastic MediaNonlinear WavesNonlinear Waves: An IntroductionNonlinear Waves and Hamiltonian SystemsAdvances in Nonlinear WavesNonlinear Ocean Waves and the Inverse Scattering TransformNew Approaches to Nonlinear WavesNonlinear WavesLinear and Nonlinear Waves Khaled Zennir Victor L. Mironov Svetlin G. Georgiev Radu Precup Changxing Miao Boling Guo Boling Guo Boling Guo Boling Guo Gerald Beresford Whitham S.S. Shen A.G. Kulikovskii Lokenath Debnath Petar Radoev Popivanov Ricardo Carretero-Gonz□lez Lokenath Debnath Alfred Osborne Elena Tobisch Tosiya Taniuti G. B. Whitham

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the book contains eleven chapters introduced by an introductory description qualitative properties for the semilinear dissipative wave equations are discussed in chapter 2 and chapter 3 based on the solutions with compactly supported initial data the purpose of chapter 4 is to present results according to the well possednes and behavior f solutions the nonlinear viscoelastic wave equations in weighted spaces elements of theory of kirchhoff problem is introduced in chapter 5 it is introduced same decay rate of second order evolution equations with density chapter 6 is devoted on the original method for well posedness and general decay for wave equation with logarithmic nonlinearities in chapter 7 it is investigated the uniform stabilization of the petrovsky wave nonlinear coupled system the question of well

posedness and general energy decay of solutions for a system of three wave equations with a nonlinear strong dissipation are investigated in chapter 8 using the weighied in sofar as chapter 9 and chapter 10 are concerned with damped nonlinear wave problems in fourier spaces the last chapter 11 analysis the existence nonexistence of solutions for structural damped wave equations with nonlinear memory terms in rn

this book is a comprehensive guide to the space time algebra of sixteen component values sedeons this algebra is designed to provide a compact representation of equations that describe various physical systems the book considers the symmetry of physical quantities concerning the operations of spatial and temporal inversion this approach allows the formulation of a wide class of mathematical physics equations within a unified framework and enables the generalization of these equations for essential problems in electrodynamics hydrodynamics plasma physics field theory and quantum mechanics in particular it is shown that the broken symmetry between electricity and magnetism in electrodynamics equations is a result of choosing an asymmetric representation of these phenomena the sedeonic algebra enables the formulation of maxwell like equations for the fields with a nonzero mass of quantum which facilitates the calculation of energy for baryon baryon interaction and the semi classical interpretation of this interaction it also allows one to generalize the hydrodynamics equations for the case of vortex turbulent flows and for a hydrodynamic two fluid model of electron ion plasma

this book is devoted to the qualitative theory of partial dynamic equations on arbitrary time scales the results in the book generalize the classical results and they unify the discrete and continuous cases the book starts with classification and canonical forms for second order pdes next the laplace transform method and the fourier transform method are introduced the fourier transform is applied to solving second order pdes the method of separation of variables is considered later in the book the following few chapters are devoted to factoring second order pdes including the wave equation the heat equation and the laplace equation it proves the weak maximum principle and as its application is investigated the stability of the solutions of the poisson equation finally the reduction of some nonlinear pdes to the wave equation the heat equation and the laplace equation are discussed the main advantage of the book is that it offers a variety of analytical techniques for the study of partial dynamical equations and that the results obtained over arbitrary time scales can be used to derive results in the classical case and in the discrete case

this introductory text combines models from physics and biology with rigorous reasoning in describing the theory of ordinary differential equations along with applications and computer simulations with maple offering a concise course in the theory of ordinary differential equations it also enables the reader to enter the field of computer simulations thus it is a valuable read for students in mathematics as well as in physics and engineering it is also addressed to all those interested in mathematical modeling with ordinary differential equations and

systems contents part i theory chapter 1 first order differential equations chapter 2 linear differential systems chapter 3 second order differential equations chapter 4 nonlinear differential equations chapter 5 stability of solutions chapter 6 differential systems with control parameters part ii exercises seminar 1 classes of first order differential equations seminar 2 mathematical modeling with differential equations seminar 3 linear differential systems seminar 4 second order differential equations seminar 5 gronwall s inequality seminar 6 method of successive approximations seminar 7 stability of solutions part iii maple code lab 1 introduction to maple lab 2 differential equations with maple lab 3 linear differential systems lab 4 second order differential equations lab 5 nonlinear differential systems lab 6 numerical computation of solutions lab 7 writing custom maple programs lab 8 differential systems with control parameters

the book places emphasis on both the mathematical significance and the strong physical background of wave equations it presents the theory of wave equations in a unique way different from the traditional descriptions provided by previous literature the book is primarily focused on mathematical ideas and thoughts about wave equations starting from the modern theory of harmonic analysis the book develops a few new tools in this field that are being used for better understanding the theory of mathematical physics underlying the well posedness and scattering theory of wave and klein gordon equations additionally a significant part of this book discusses theories and methods such as invariant and conservation laws inward outward energy methods etc that have never been covered by similar books in this field finally the book briefly introduces recent developments in mathematical fields it is specially designed for experts in mathematics and physics who deal with numerous applications of nonlinear waves in physics engineering biology and other fields

this book provides an up to date overview of mathematical theories and research results on solitons presenting related mathematical methods and applications as well as numerical experiments different types of soliton equations are covered along with their dynamical behaviors and applications from physics making the book an essential reference for researchers and graduate students in applied mathematics and physics contents introduction inverse scattering transform asymptotic behavior to initial value problems for some integrable evolution nonlinear equations interaction of solitons and its asymptotic properties hirota method bäcklund transformations and the infinitely many conservation laws multi dimensional solitons and their stability numerical computation methods for some nonlinear evolution equations the geometric theory of solitons global existence and blow up for the nonlinear evolution equations the soliton movements of elementary particles in nonlinear quantum field the theory of soliton movement of superconductive features the soliton movements in condensed state systemsontents

this book provides an up to date overview of mathematical theories and research results in non newtonian fluid dynamics related mathematical models solutions as well as numerical experiments are discussed fundamental theories and practical applications make it a

handy reference for researchers and graduate students in mathematics physics and engineering contents non newtonian fluids and their mathematical model global solutions to the equations of non newtonian fluids global attractors of incompressible non newtonian fluids global attractors of modified boussinesq approximation inertial manifolds of incompressible non newtonian fluids the regularity of solutions and related problems global attractors and time spatial chaos non newtonian generalized fluid and their applications

this two volume work presents state of the art mathematical theories and results on infinite dimensional dynamical systems inertial manifolds approximate inertial manifolds discrete attractors and the dynamics of small dissipation are discussed in detail the unique combination of mathematical rigor and physical background makes this work an essential reference for researchers and graduate students in applied mathematics and physics the main emphasis in the fi rst volume is on the existence and properties for attractors and inertial manifolds this volume highlights the use of modern analytical tools and methods such as the geometric measure method center manifold theory in infinite dimensions the melnihov method spectral analysis and so on for infinite dimensional dynamical systems the second volume includes the properties of global attractors the calculation of discrete attractors structures of small dissipative dynamical systems and the existence and stability of solitary waves contents discrete attractor and approximate calculation some properties of global attractor structures of small dissipative dynamical systems existence and stability of solitary waves

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the aim of this book is to give a self contained introduction to the mathe matical analysis and physical explanations of some basic nonlinear wave phe nomena this volume grew out of lecture notes for graduate courf es which i gave at the university of alberta the university of saskatchewan and texas a m university as an introduction it is not intended to be exhaustive iq its choice of material but rather to convey to interested readers a basic yet practical methodology as well as some of the more important results obtained since the 1950 s although the

primary purpose of this volume is to serve as a textbook it should be useful to anyone who wishes to understand or conduct research into nonlinear waves here for the first time materials on x ray crystallography and the forced korteweg de vries equation are incorporated naturally into a textbook on non linear waves another characteristic feature of the book is the inclusion of four symbolic calculation programs written in mathematica they emphasize outcomes rather than numerical methods and provide certain symbolic and nu merical results related to solitons requiring only one or two commands to run these programs have user friendly interfaces for example to get the explicit expression of the 2 soliton of the korteweg de vries equation one only needs to type in soliton 2 when using the program solipac m

nonlinear waves in elastic media explores the theoretical results of one dimensional nonlinear waves including shock waves in elastic media it is the first book to provide an in depth and comprehensive presentation of the nonlinear wave theory while taking anisotropy effects into account the theory is completely worked out and draws on 15 years of research by the authors one of whom also wrote the 1965 classic magnetohydrodynamics nonlinear waves in elastic media emphasizes the behavior of quasitransverse waves and analyzes arbitrary discontinuity disintegration problems illustrating that the solution can be non unique a surprising result the solution is shown to be especially interesting when anisotropy and nonlinearity effects interact even in small amplitude waves in addition the text contains an independent mathematical chapter describing general methods to study hyperbolic systems expressing the conservation laws the theoretical results described in nonlinear waves in elastic media allow for the first time discovery and interpretation of many new peculiarities inherent to the general problem of discontinuous solutions and so provide a valuable resource for advanced students and researchers involved with continuum mechanics and partial differential equations

the outcome of a conference held in east carolina university in june 1982 this book provides an account of developments in the theory and application of nonlinear waves in both fluids and plasmas twenty two contributors from eight countries here cover all the main fields of research including nonlinear water waves k dv equations solitions and inverse scattering transforms stability of solitary waves resonant wave interactions nonlinear evolution equations nonlinear wave phenomena in plasmas recurrence phenomena in nonlinear wave systems and the structure and dynamics of envelope solitions in plasmas

this book deals with equations of mathematical physics as the different modifications of the kdv equation the camassa holm type equations several modifications of burger s equation the hunter saxton equation and others the equations originate from physics but are proposed here for their investigation via purely mathematical methods in the frames of university courses more precisely the authors propose classification theorems for the traveling wave solutions for a sufficiently large class of third order nonlinear pde when the corresponding profiles develop different kind of singularities cusps peaks the orbital stability of the periodic solutions of traveling type for mkdv

equations are also studied of great interest too is the interaction of peakon type solutions of the camassa holm equation and the solvability of the classical and generalized cauchy problem for the hunter saxton equation the riemann problem for special systems of conservation laws and the corresponding d shocks are also considered at the end of the book the authors study the interaction of two piecewise smooth waves in the case of two space variables and they verify the appearance of logarithmic singularities as it concerns numerical methods in the case of periodic waves the authors apply cellular neural network cnn approach

nonlinear waves are of significant scientific interest across many diverse contexts ranging from mathematics and physics to engineering biosciences chemistry and finance the study of nonlinear waves is relevant to bose einstein condensates the interaction of electromagnetic waves with matter optical fibers and waveguides acoustics water waves atmospheric and planetary scales and even galaxy formation the aim of this book is to provide a self contained introduction to the continuously developing field of nonlinear waves that offers the background the basic ideas and mathematical as well as computational methods while also presenting an overview of associated physical applications originated from the authors own research activity in the field for almost three decades and shaped over many years of teaching on relevant courses the primary purpose of this book is to serve as a textbook however the selection and exposition of the material will be useful to anyone who is curious to explore the fascinating world of nonlinear waves

for more than 200 years the fourier transform has been one of the most important mathematical tools for understanding the dynamics of linear wave trains nonlinear ocean waves and the inverse scattering transform presents the development of the nonlinear fourier analysis of measured space and time series which can be found in a wide variety of physical settings including surface water waves internal waves and equatorial rossby waves this revolutionary development will allow hyperfast numerical modelling of nonlinear waves greatly advancing our understanding of oceanic surface and internal waves nonlinear fourier analysis is based upon a generalization of linear fourier analysis referred to as the inverse scattering transform the fundamental building block of which is a generalized fourier series called the riemann theta function elucidating the art and science of implementing these functions in the context of physical and time series analysis is the goal of this book presents techniques and methods of the inverse scattering transform for data analysis geared toward both the introductory and advanced reader venturing further into mathematical and numerical analysis suitable for classroom teaching as well as research

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

now in an accessible paperback edition this classic work is just as relevant as when it first appeared in 1974 due to the increased use of nonlinear waves it covers the behavior of waves in two parts with the first part addressing hyperbolic waves and the second addressing dispersive waves the mathematical principles are presented along with examples of specific cases in communications and specific physical fields including flood waves in rivers waves in glaciers traffic flow sonic booms blast waves and ocean waves from storms

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Introduction

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