Nonlinear Waves

Nonlinear Wave EquationsA Course on Nonlinear WavesNonlinear WavesNonlinear Waves in Integrable and Non-integrable SystemsNew Approaches to Nonlinear WavesLinear and Nonlinear WavesNonlinear Waves in Elastic MediaNonlinear Waves: An IntroductionNonlinear Ocean Waves and the Inverse Scattering TransformPhysics of Nonlinear WavesAdvances in Nonlinear WavesIntroduction to the Mathematical Physics of Nonlinear WavesNonlinear Waves In Bounded Media: The Mathematics Of ResonanceNonlinear WavesNonlinear Waves and SolitonsNonlinear Wave EquationsNonlinear Waves in Fluids: Recent Advances and Modern ApplicationsNonlinear Waves in Inhomogeneous and Hereditary MediaNonlinear WavesXian Xing Yu Fei Xian Xing Bo Walter A. Strauss S.S. Shen Lokenath Debnath Jianke Yang Elena Tobisch G. B. Whitham A.G. Kulikovskii Petar Radoev Popivanov Alfred Osborne Mitsuhiro Tanaka Lokenath Debnath Minoru Fujimoto Brian R Seymour Tosiya Taniuti M. Toda Satyanad Kichenassamy Roger Grimshaw Aleksandr Aleksandrovich Lokshin M D Todorov Gerald Beresford Whitham

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the theory of nonlinear wave equations in the absence of shocks began in the 1960s despite a great deal of recent activity in

this area some major issues remain unsolved such as sharp conditions for the global existence of solutions with arbitrary initial data and the global phase portrait in the presence of periodic solutions and traveling waves this book based on lectures presented by the author at george mason university in january 1989 seeks to present the sharpest results to date in this area the author surveys the fundamental qualitative properties of the solutions of nonlinear wave equations in the absence of boundaries and shocks these properties include the existence and regularity of global solutions strong and weak singularities asymptotic properties scattering theory and stability of solitary waves wave equations of hyperbolic schrodinger and kdv type are discussed as well as the yang mills and the vlasov maxwell equations the book offers readers a broad overview of the field and an understanding of the most recent developments as well as the status of some important unsolved problems intended for mathematicians and physicists interested in nonlinear waves this book would be suitable as the basis for an advanced graduate level course

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

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

nonlinear waves in integrable and nonintegrable systems presents cutting edge developments in the theory and experiments of nonlinear waves its comprehensive coverage of analytical and numerical methods for nonintegrable systems is the first of its kind this book is intended for researchers and graduate students working in applied mathematics and various physical subjects where nonlinear wave phenomena arise such as nonlinear optics bose einstein condensates and fluid dynamics

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

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

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

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

this is an introductory book about nonlinear waves it focuses on two properties that various different wave phenomena have in common the nonlinearity and dispersion and explains them in a style that is easy to understand for first time students both of these properties have important effects on wave phenomena nonlinearity for example makes the wave lean forward and leads to wave breaking or enables waves with different wavenumber and frequency to interact with each other and exchange their energies dispersion for example sorts irregular waves containing various wavelengths into gentler wavetrains with almost uniform wavelengths as they propagate or cause a difference between the propagation speeds of the wave waveform and the wave energy many phenomena are introduced and explained using water waves as an example but this is just a tool to make it easier to draw physical images most of the phenomena introduced in this book are common to all nonlinear and dispersive waves this book focuses on understanding the physical aspects of wave phenomena and requires very little mathematical knowledge the necessary minimum knowledges about fourier analysis perturbation method dimensional analysis the governing equations of water waves etc are provided in the text and appendices so even second or third year undergraduate students will be able to fully understand the contents of the book and enjoy the fan of nonlinear wave phenomena without relying on other books

nonlinear physics is a well established discipline in physics today and this book offers a comprehensive account of the basic soliton theory and its applications although primarily mathematical the theory for nonlinear phenomena in practical environment

this unique book aims to treat a class of nonlinear waves that are reflected from the boundaries of media of finite extent it involves both standing unforced waves and resonant oscillations due to external periodic forcing the waves are both

hyperbolic and dispersive to achieve this aim the book develops the necessary understanding of linear waves and the mathematical techniques of nonlinear waves before dealing with nonlinear waves in bounded media the examples used come mainly from gas dynamics water waves and viscoelastic waves

it is certainly a beautiful presentation very well adapted to teaching beginners i am sure this book will be successful inverse problems 1990

this work examines the mathematical aspects of nonlinear wave propagation emphasizing nonlinear hyperbolic problems it introduces the tools that are most effective for exploring the problems of local and global existence singularity formation and large time behaviour of solutions and for the study of perturbation methods

although nonlinear waves occur in nearly all branches of physics and engi neering there is an amazing degree of agreement about the fundamental con cepts and the basic paradigms the underlying unity of the theory for linearized waves is already well established with the importance of such universal concepts as group velocity and wave superposition for nonlinear waves the last few decades have seen the emergence of analogous unifying comcepts the pervasiveness of the soliton concept is amply demonstrated by the ubiquity of such models as the korteweg de vries equation and the nonlinear schrodinger equation similarly there is a universality in the study of wave wave interactions whether determin istic or statistical and in the recent developments in the theory of wave mean flow interactions the aim of this text is to present the basic paradigms of weakly nonlinear waves in fluids this book is the outcome of a cism summer school held at udine from september 20 24 2004 like the lectures given there the text covers asymptotic methods for the derivation of canonical evolution equations such as the kortew de vries and nonlinear schrodinger equations descriptions of the basic solution sets of these evolution equations and the most relevant and compelling applica tions these themes are interlocked and this will be demonstrated throughout the text the topics address any fluid flow application but there is a bias towards geophysical fluid dynamics reflecting for the most part the areas where many applications have been found

the boussinesq equation is the first model of surface waves in shallow water that considers the nonlinearity and the dispersion and their interaction as a reason for wave stability known as the boussinesq paradigm this balance bears solitary waves that behave like quasi particles at present there are some boussinesq like equations the prevalent part of the known analytical and numerical solutions however relates to the 1d case while for multidimensional cases almost nothing is known

so far an exclusion is the solutions of the kadomtsev petviashvili equation the difficulties originate from the lack of known analytic initial conditions and the nonintegrability in the multidimensional case another problem is which kind of nonlinearity will keep the temporal stability of localized solutions the system of coupled nonlinear schroedinger equations known as well as the vector schroedinger equation is a soliton supporting dynamical system it is considered as a model of light propagation in kerr isotropic media along with that the phenomenology of the equation opens a prospect of investigating the quasi particle behavior of the interacting solitons the initial polarization of the vector schroedinger equation and its evolution evolves from the vector nature of the model the existence of exact analytical solutions usually is rendered to simpler models while for the vector schroedinger equation such solutions are not known this determines the role of the numerical schemes and approaches the vector schroedinger equation is a spring board for combining the reduced integrability and conservation laws in a discrete level the experimental observation and measurement of ultrashort pulses in waveguides is a hard job and this is the reason and stimulus to create mathematical models for computer simulations as well as reliable algorithms for treating the governing equations along with the nonintegrability one more problem appears here the multidimensionality and necessity to split and linearize the operators in the appropriate way

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