Basic Of Solitons

INTRODUCTION TO OPTICAL FIBER Recent inventions and discoveries have revolutionized the telecommunication industry, but the future enhancement will based on the transmission and reception of multimedia in an efficient and effective way. In present, optical fibers are used instead of copper cables, which is very helpful to transform plenty of information with high speed and high range. The optical fiber cable gives infinite bandwidth for media transmission with low loss. The optical fiber is a cylindrical in shape and made up of low loss dielectric material such as silica glass. An optical or light signal communication is a system which use light pulse as the carrier for transmission and reception of signals. The silica glass fiber has low loss, higher bandwidth and high speed compare to normal copper cable communication. Nowadays the copper coaxial cables are replaced by optical fiber due to low loss in fiber and offers infinite bandwidth with low latency. Thus the fiber plays a major role in today's global application such as Telecommunication, defence, medical, networking, industrial, etc.

The book is devoted to the mathematical theory of soliton phenomena on the plane. The inverse spectral transform method which is a main tool for the study of the (2+1)-dimensional soliton equation is reviewed. The ?-problem and the Riemann-Hilbert problem method are discussed. Several basic examples of soliton equations are considered in detail. This volume is addressed both to the nonexpert and to the researcher in the field. This is the first literature dealing specifically with multidimensional solition equations. Contents:IntroductionDressing Method, The Kadomtsev-Petviashvili EquationThe Modified Kadomtsev-Petviashvili EquationThe Davey-Stewartson EquationThe Ishimori EquationThe 2+1-Dimensional Integrable Sine-Gordon EquationExtensions of the ?-Dressing Method Readership: Applied mathematicians, mathematical physicists and researchers in chaos and in nonlinear sciences. keywords:Bibliography;Korteweg De Vries Equation;Dressing Method;Riemann-Hilbert Problems;Inverse Scattering Transform;Kadomtsev-Petviashvili Equations;Modified Kadomtsev-Petviashvili Equations;Modified Korteweg- De Vries Equation;Miura Transform;Davey-Stewartson Equations;Ishimori Equations;Heisenberg-Ferromagnet Model;Sine-Gordon Equation "The remarkable discovery for the algebraic structure governing the sequence of conserved quantities in the kdV, KP or non-linear Schrödinger dynamics was a long time restricted to a one-dimensional spatial coordinate system. The multidimensional analogs are much harder and for this reason very intriguing to tame. The book by Konopelchenko offers a first organized exposition of the inverse spectral transform technique applied to 2D integrable systems of the same category. The elegant and original combination of complex analysis, spectral theory and infinite dimensional algebra is a high mark of this text." Professor Mihai Putinar University of California at Santa Barbara

The second edition of a highly successful book on nonlinear waves, solitons and chaos.

Despite remarkable developments in the field, a detailed treatment of non-Kerr law media has not been published. Introduction to non-Kerr Law Optical Solitons is the first book devoted exclusively to optical soliton propagation in media that possesses non-Kerr law nonlinearities. After an introduction to the basic features of fiber-optic com

Nonlinearity is a fascinating element of nature whose importance has been appreciated for many years when considering large-amplitude wave motions observed in various fields ranging from fluids and plasmas to solid-state, chemical, biological, and geological systems. Localized large-amplitude waves called solitons, which propagate without spreading and have particle-like properties, represent one of the most striking aspects of nonlinear phenomena. Although a wealth of literature on the subject, including theoretical and numerical studies, is available in good recent books and research journals, very little material has found its way into introductory texbooks and curricula. This is perhaps due to a belief that nonlinear physics is difficult and cannot be taught at an introductory level to undergraduate students and practitioners. Consequently, there is considerable interest in developing practical material suitable for students, at the lowest introductory level. This book is intended to be an elementary introduction to the physics of solitons, for students, physicists, engineers and practitioners. We present the modeling of nonlinear phenomena where soliton-like waves are involved, together with applications to a wide variety of concrete systems and experiments. This book is designed as a book of physical ideas and basic methods and not as an up-to-the minute book concerned with the latest research results. The background in physics and the amount of mathematical knowledge assumed of the reader is within that usually accumulated by junior or senior students in physics.

Optical Solitons represent one of the most exciting and fascinating concepts in modern communications, arousing special interest due to their potential applications in optical fibre communication. This volume focuses on the explicit integration of analytical and experimental methods in nonlinear fibre optics and integrated optics. It covers all important recent technical issues in optical-soliton communication. For example, individual chapters are devoted to topics such as dispersion management and fibre Bragg grating. All authors are leading authorities in their fields.

Basic Methods Of Soliton TheoryWorld Scientific

A good deal of the material presented in this book has been prepared by top experts in the field lecturing in January 1987 at the Winter School on Solitons in Tiruchirapalli,India. The lectures begin at an elementary level but go on to include even the most recent developments in the field. The book makes a handy introduction to the various facets of the soliton concept, and will be useful both to newcomers to the field and to researchers who are interested in developments in new branches of physics and mathematics.

This volume is an introduction to nonlinear waves and soliton theory in the special environment of compact spaces such a closed curves and surfaces and other domain contours. It assumes familiarity with basic soliton theory and nonlinear dynamical systems. The first part of the book introduces the mathematical concept required for treating the manifolds considered, providing relevant notions from topology and differential geometry. An introduction to the theory of motion of curves and surfaces - as part of the emerging field of contour dynamics - is given. The second and third parts discuss the modeling of various physical solitons on compact systems, such as filaments, loops and drops made of almost incompressible materials thereby intersecting with a large number of physical disciplines from hydrodynamics to compact object astrophysics. This book is intended for graduate students and researchers in mathematics, physics and engineering. This new edition has been thoroughly revised, expanded and updated.

Readership: Physicists, mathematicians and mathematical physicists.

This second edition of Digital Optical Communications provides a comprehensive treatment of the modern aspects of coherent homodyne and self-coherent reception techniques using algorithms incorporated in digital signal processing (DSP) systems and DSP-based transmitters to overcome several linear and nonlinear transmission impairments and frequency mismatching between the local oscillator and the carrier, as well as clock recovery and cycle slips. These modern transmission systems have emerged as the core technology for Tera-bits per second (bps) and Peta-bps optical Internet for the near future. Featuring extensive updates to all existing chapters, Advanced Digital Optical Communications, Second Edition: Contains new chapters on optical fiber structures and propagation, optical coherent receivers, DSP equalizer algorithms, and high-order spectral DSP receivers Examines theoretical foundations, practical case studies, and MATLAB® and Simulink® models for simulation transmissions Includes new end-of-chapter practice problems and useful appendices to supplement technical information Downloadable content available with qualifying course adoption Advanced Digital Optical Communications, Second Edition supplies a fundamental understanding of digital communication applications in optical communication technologies, emphasizing operation principles versus heavy mathematical analysis. It is an ideal text for aspiring engineers and a valuable professional reference for those involved in optics, telecommunications, electronics, photonics, and digital signal processing.

This book will be a valuable addition to the growing literature in the area and essential reading for all researchers in the field of soliton theory.

Solitons are waves that retain their form through obstacle and distance. Solitons can be found in hydrodynamics, nonlinear optics, plasma physics, and biology. Optical solitons are solitary light waves that hold their form over an expansive interval. Conservation of this form creates an effective model for long distance voice and data transmission. The application of this principle is essential to the technology of wired communications. Optical solitons produce crystal clear phone calls cross-country and internationally. It is because of these that someone on the other end of the phone sounds 'in the next room.' It is also pertinent to high-speed network information transmittal. Mollenauer and Gordon have written the only text that an engineer or graduate student will need to understand this foundation subject in optics. *Written by Linn Mollenauer and James Gordon who are celebrated for applying optical solitons to telecommnications *Combines mathematical developments with well-chosen practical examples and design formulas *Extensive material on the basic physics of fiber optic transmission and its practical applications

Solitary wave physics plays a significant role from modern optical physics to optical communication, optical switching and optical storage. This book gives an updated overview of optical solitons, as a reference and guide for advanced students and scientists working in the field.

Soliton theory is an important branch of applied mathematics and mathematical physics. An active and productive field of research, it has important applications in fluid mechanics, nonlinear optics, classical and quantum fields theories etc. This book presents a broad view of soliton theory. It gives an expository survey of the most basic ideas and methods, such as physical background, inverse scattering, Backlünd transformations, finite-dimensional completely integrable systems, symmetry, Kac-moody algebra, solitons and differential geometry, numerical analysis for nonlinear waves, and gravitational solitons. Besides the essential points of the theory, several applications are sketched and some recent developments, partly by the authors and their collaborators, are presented.

Optical Multi-Bound Solitons describes the generation and transmission of multi-bound solitons with the potential to form the basis of the temporal coding of optical data packets for next-generation nonlinear optical systems. The book deals with nonlinear systems in terms of their fundamental principles, associated phenomena, and signal processing applications in contemporary optical systems for communications and laser systems, with a touch of mathematical representation of nonlinear equations to offer insight into the nonlinear dynamics at different phases. The text not only delineates the strong background physics of such systems but also: Discusses the phase evolution of the optical carriers under the soliton envelopes for the generation of multi-bound solitons Explains the generation of multi-bound solitons through optical fibers Examines new types of multi-bound solitons in passive and active optical resonators Conducts bi-spectral analyses of multi-bound solitons to identify the phase and power amplitude distribution property of bound solitons Presents experimental techniques for the effective generation of bound solitons Optical Multi-Bound Solitons provides extensive coverage of multi-bound solitons from the dynamics of their formation to their transmission over guided optical media. Appendices are included to supplement a number of essential definitions, mathematical representations, and derivations, making this book an ideal theoretical reference text as well as a practical professional guidebook.

1.1 Why Study Solitons? The last century of physics, which was initiated by Maxwell's completion of the theory of electromagnetism, can, with some justification, be called the era of linear physi cs. ~Jith few excepti ons, the methods of theoreti ca 1 phys ics have been dominated by linear equations (Maxwell, Schrodinger), linear mathematical objects (vector spaces, in particular Hilbert spaces), and linear methods (Fourier transforms, perturbation theory, linear response theory) . Naturally the importance of nonlinearity, beginning with the Navier-Stokes equations and continuing to gravitation theory and the interactions of par ticles in solids, nuclei, and quantized fields, was recognized. However, it was hardly possible to treat the effects of nonlinearity, except as a per turbation to the basis solutions of the linearized theory. During the last decade, it has become more widely recognized in many areas of "field physics" that nonlinearity can result in qualitatively new phenom ena which cannot be constructed via perturbation theory starting from linear ized equations. By "field physics" we mean all those areas of theoretical physics for which the description of physical phenomena leads one to consider field equations, or partial differential equations of the form (1.1.1) ~t or ~tt = F(~, ~x ...) for one- or many-component "fields" Ht, x, y ...) (or their quantum analogs).

During the past ten years, there has been intensive development in theoretical and experimental research of solitons in periodic media. This book provides a unique and informative account of the state-of-the-art in the field. The volume opens with a review of the existence of robust solitary pulses in systems built as a periodic concatenation of very different elements. Among the most famous examples of this type of systems are the dispersion management in fiber-optic telecommunication links, and (more recently) photonic crystals. A number of other systems belonging to the same broad class of spatially periodic strongly inhomogeneous media (such as the split-step and tandem models) have recently been identified in nonlinear optics, and transmission of solitary pulses in them was investigated in detail. Similar soliton dynamics occurs in temporal-domain counterparts of such systems, where they are subject to strong time-periodic modulation (for instance, the Feshbach-resonance management in Bose-Einstein condensates). Basis results obtained for all these systems are reviewed in the book. This timely work will serve as a useful resource for the soliton community.

This book summarizes the proceedings of the invited talks presented at the International Symposium of Physics and Application of Optical Solitons in Fibers held in Kyoto during November 14 to 17,1995. As a result of worldwide demand for ultra high bitrate transmissions and increased scientific interests from the soliton community, research on optical solitons in fibers has made a remarkable progress in recent years. In view of these trends, and with the support of the Japanese Ministry of Posts and Telecommunications, the Research Group for Optical Soliton Communications (ROSC), chaired by Akira Hasegawa, was established in Japan in April 1995 to promote collaboration and information exchange 'among communication service companies, industries and academic circles in the theory and application of optical solitons. This symposium was organized as a part of the ROSC activities. The symposium attracted enthusiastic response by worldwide researchers involved in this subject which has lead to the most intensive meeting that the editor ever attended. The reader will find the contents to be well-balanced among theory, experiment and technology. Although the evaluation of the contents shall naturally depend on the particular area of interest of the reader, the symposium has confirmed that the soliton based light wave transmission has achieved the best result in one channel, both in distance of transmission and in bitrate although in wavelength division multiplexed (WDM) systems, NRZ transmission has yet better result.

Written for an interdisciplinary readership, this book is a practical guide to the fascinating world of solitons. The author approaches the subject from the standpoint of applications in optics, hydrodynamics, and electrical and chemical engineering. This third edition has been thoroughly revised and updated.

This textbook gives an instructive view of solitons and their applications for advanced students of physics.

1 2 V. E. Zakharov and S. Wabnitz 1 L. D. Landau Institute for Theoretical Physics, 2 Kosygin Str. , 117334 Moscow, Russia 2 Laboratoire de Physique, University of Bourgogne, 9 avenue A. Savary, 21078 Dijon, France After about a quarter of a century since the first theoretical predictions of op tical solitons, the industrial application of the optical soliton concept is near to reality in the booming field of modern telecommunications, where the de mand for high-speed data transmission and routing is of ever-growing. This book contains a set of lectures that were presented at a Les Houches school on optical solitons in September 1998.

The school was successful in gathering among the lecturers most of the well-recognized world leaders in the field of optical solitons. A variety of different aspects of research into optical solitons was exposed in the lectures, ranging from the mathematical fundations of integrability theory to the rapidly evolving technological advances of fiber soliton-based telecommu nication systems. The overall impression that the participants and the students received from the school is that this field of research is an excellent example of the rapid transfer that occurs nowadays from basic science to the technological implementations of the first principles. The subjects that were covered by the lectures can be broadly grouped into four main categories: optical soliton the ory, fiber soliton telecommunications, optical soliton generation methods, and all-optical information processing via spatial solitons.
Provides an overview of our current understanding of optical soliton properties introducing the subject for students and reviewing the most recent research.
It is ironic that the ideas ofNewton, which described a beam of light as a stream ofparticles made it difficult for him to explain things like thin film interference. Yet these particles, called 'photons', have caused the adjective 'photonic' to gain common usage, when referring to optical phenomena. The purist might argue that only when we are confronted by the particle nature of light should we use the word photonics. Equally, the argument goes on, only when we are face-to face with an integrable system, i. e. one that possesses an infinite number of conserved quantities, should we say soliton rather than solitary wave. Scientists and engineers are pragmatic, however, and they are happy to use the word 'soliton' to describe what appears to be an excitation that is humped, multi humped, or localised long enough for some use to be made of it. The fact that such 'solitons' may stick to each other (fuse) upon collision is often something to celebrate for an application, rather than just evidence that, after all, these are not really solitons, in the classic sense. 'Soliton', therefore, is a widely used term with the qualification that we are constantly looking out for deviant behaviour that draws our attention to its solitary wave character. In the same spirit, 'photonics' is a useful generic cover-all noun, even when 'electromagnetic theory' or 'optics' would suffice.
This book summarizes the proceedings of the invited talks presented at the International Symposium on New Trends in Optical Soliton Transmission Systems held in Kyoto during November 18 - 21, 1997. As a result of worldwide demand for ultra high bitrate transmissions and increased scientific interest from the soliton community, research on optical solitons in fibres has made remarkable progress in recent years. In view of these trends, the Research Group for Optical Soliton Communications (ROSC), chaired by Akira Hasegawa, was established in Japan in April 1995 to promote collaboration and information exchange among communication service companies, industries and academic circles in the theory and application of optical solitons. This symposium was organized as a part of the ROSC activities. As with the 1 st ROSC symposium, this symposium attracted enthusiastic response from worldwide researchers involved in the subject of soliton based communications and intensive discussions were held throughout the symposium. Particular emphases were made to dispersion managements of soliton transmission. I would like to note that in the }'t symposium the (adiabatic)

dispersion managements just began to appear in reducing radiation at amplifiers and reducing collision effects in WDM system. These have become standard this time, but in addition new, non-adiabatic dispersion managements have been introduced independently by various scientists all over the world.

In the twenty years since Zabusky and Kruskal coined the term ``soliton'', this concept changed the outlook on certain types of nonlinear phenomena and found its way into all branches of physics. The present volume deals with a great variety of applications of the new concept in condensed-matter physics, which is particularly reached in experimentally observable occurrences. The presentation is not centred around the mathematical aspects; the emphasis is on the physical nature of the nonlinear phenomena occurring in particular situations. With its emphasis on concrete, mostly experimentally verifiable cases, ``Solitons'' constitutes a very readable and instructive introduction to the subject as well as an up-to-date account of current developments in a field of research reaching maturity.

This IMA Volume in Mathematics and its Applications SOLITONS IN PHYSICS, MATHEMATICS, AND NONLINEAR OPTICS is based on the proceedings of two workshops which were an integral part of the 1988-89 IMA program on NONLINEAR WAVES. The workshops focussed on the main parts of the theory of solitons and on the applications of solitons in physics, biology and engineering, with a special concentration on nonlinear optics. We thank the Coordinating Committee: James Glimm, Daniel Joseph, Barbara Keyfitz, An Majda, Alan Newell, Peter Olver, David Sattinger and David Schaeffer for drew planning and implementing the stimulating year-long program. We especially thank the Workshop Organizers for Solitons in Physics and Mathematics, Alan Newell, Peter Olver, and David Sattinger, and for Nonlinear Optics and Plasma Physics, David Kaup and Yuji Kodama for their efforts in bringing together many of the major figures in those research fields in which solitons in physics, mathematics, and nonlinear optics theories are used. A vner Friedman Willard Miller, Jr. PREFACE This volume includes some of the lectures given at two workshops, "Solitons in Physics and Mathematics" and "Solitons in Nonlinear Optics and Plasma Physics" held during the 1988-89 LM. A. year on Nonlinear Waves. Since their discovery by Kruskal and Zabusky in the early 1960's, solitons have had a profound impact on many fields, ranging from engineering and physics to algebraic geometry.

The current research into solitons and their use in fiber optic communications is very important to the future of communications. Since the advent of computer networking and high speed data transmission technology people have been striving to develop faster and more reliable communications media. Optical pulses tend to broaden over relatively short distances due to dispersion, but solitons on the other hand are not as susceptible to the effects of dispersion, and although they are subject to losses due to attenuation they can be amplified without being received and re-transmitted. This book is the first to provide a thorough overview of optical solitons. The main purpose of this book is to present the rapidly developing field of Spatial Optical Solitons starting from the basic concepts of light self-focusing and self-trapping. It will introduce the fundamental concepts of the theory of nonlinear waves and solitons in non-integrated but physically realistic models of nonlinear optics including their stability and dynamics. Also, it will summarize a number of important experimental verification of the basic theoretical predictions and concepts covering the observation of self-focusing in the earlier days of nonlinear optics and the most recent experimental results on spatial solitons, vortex solitons, and soliton interaction & spiraling. * Introduces the fundamental concepts of the theory of nonlinear waves and solitons through realistic models * Material is based on authors' years of experience actively working in and researching the field * Summarizes the most important experimental verification of the basic theories, predictions and concepts of this ever evolving field from the earliest studies to the most recent

Solitons are explicit solutions to nonlinear partial differential equations exhibiting particle-like behavior. This is quite surprising, both mathematically and physically. Waves with these properties were once believed to be impossible by leading mathematical physicists, yet they are now not only accepted as a theoretical possibility but are regularly observed in nature and form the basis of modern fiber-optic communication networks. Glimpses of Soliton Theory addresses some of the hidden mathematical connections in soliton theory which have been revealed over the last half-century. It aims to convince the reader that, like the mirrors and hidden pockets used by magicians, the underlying algebro-geometric structure of soliton equations provides an elegant and surprisingly simple explanation of something seemingly miraculous. Assuming only multivariable calculus and linear algebra as prerequisites, this book introduces the reader to the KdV Equation and its multisoliton solutions, elliptic curves and Weierstrass -functions, the algebra of differential operators, Lax Pairs and their use in discovering other soliton equations, wedge products and decomposability, the KP Equation and Sato's theory relating the Bilinear KP Equation to the geometry of Grassmannians. Notable features of the book include: careful selection of topics and detailed explanations to make this advanced subject accessible to any undergraduate math major, numerous worked examples and thought-provoking but not overly-difficult exercises, footnotes and lists of suggested readings to guide the interested reader to more information, and use of the software package Mathematica« to facilitate computation and to animate the solutions under study. This book provides the reader with a unique glimpse of the unity of mathematics and could form the basis for a self-study, one-semester special topics, or "capstone" course.

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 is an elementary introduction to the fascinating world of waves called solitons. These large-amplitude waves, which can propagate over long distances without dispersing and which display particle-like properties, are one of the most striking manifestations of nonlinearity. The main concepts are introduced at an elementary level accessible to the undergraduate. In a self-contained and interdisciplinary whole, such topics as electrical, hydrodynamic, chemical, and optical solitons, are discussed. Many of the author's choices of emphasis have been made with experiments in mind; several experiments can readily be performed by the reader. This book is not meant for specialists but for students, physicists, engineers, and practitioners. The chapters are independently written in order that the reader should quickly find the required information. The second edition of this highly praised book has new material, especially on nonlinear transmission lines, on various forms of modulational instabilities, and on quantum optical solitons.

Topological solitons occur in many nonlinear classical field theories. They are stable, particle-like objects, with finite mass and a smooth structure. Examples are monopoles and Skyrmions, Ginzburg-Landau vortices and sigma-model lumps, and Yang-Mills instantons. This book is a comprehensive survey of static topological solitons and their dynamical interactions. Particular emphasis is placed on the solitons which satisfy first-order Bogomolny equations. For these, the soliton dynamics can be investigated by finding the geodesics on the moduli space of static multi-soliton solutions. Remarkable scattering processes can be understood this way. The book starts with an introduction to classical field theory, and a survey of several mathematical techniques useful for understanding many types of topological soliton. Subsequent chapters explore key examples of solitons in one, two, three and four dimensions. The final chapter discusses the unstable sphaleron solutions which exist in several field theories.

This textbook is an introduction to the theory of solitons in the physical sciences.

Why writing a book about a specialized task of the large topic of complex systems? And who will read it? The answer is simple: The fascination for a didactically valuable point of view, the elegance of a closed concept and the lack of a comprehensive disquisition. The fascinating part is that field equations can have localized solutions exhibiting the typical characteristics of particles. Regarding the field equations this book focuses on, the field phenomenon of localized solutions can be described in the context of a particle formalism, which leads to a set of ordinary differential equations covering the time evolution of the position and the velocity of each particle. Moreover, starting from these particle dynamics and making the transition to many body systems, one considers typical phenomena of many body systems as shock waves and phase transitions, which themselves can be described as field phenomena. Such transitions between different level of modelling are well known from conservative systems, where localized solutions of quantum field theory lead to the mechanisms of elementary particle interaction and from this to field equations describing the properties of matter. However, in dissipative systems such transitions have not been considered yet, which is adjusted by the presented book. The elegance of a closed concept starts with the observation of self-organized current filaments in a semiconductor gas discharge system. These filaments move on random paths and exhibit certain particle features like scattering or the formation of bound states. Neither the reasons for the propagation of the filaments nor the laws of the interaction between the filaments can be registered by direct observations. Therefore a model is established, which is phenomenological in the first instance due to the complexity of the experimental system. This model allows to understand the existence of localized structures, their mechanisms of movement, and their interaction, at least, on a qualitative level. But this model is also the starting point for developing a data analysis method that enables the detection of movement and interaction mechanisms of the investigated localized solutions. The topic is rounded of by applying the data analysis to real experimental data and comparing the experimental observations to the predictions of the model. A comprehensive publication covering the interesting topic of localized solutions in reaction diffusion systems in its width and its relation to the well known phenomena of spirals and patterns does not yet exist, and this is the third reason for writing this book. Although the book focuses on a specific experimental system the model equations are as simple as possible so that the discussed methods should be adaptable to a large class of systems showing particle-like structures. Therefore, this book should attract not only the experienced scientist, who is interested in self-organization phenomena, but also the student, who would like to understand the investigation of a complex system on the basis of a continuous description.

In the 25 years of its existence Soliton Theory has drastically expanded our understanding of “integrability” and contributed a lot to the reunification of Mathematics and Physics in the range from deep algebraic geometry and modern representation theory to quantum field theory and optical transmission lines.The book is a systematic introduction to the Soliton Theory with an emphasis on its background and algebraic aspects. It is the first one devoted to the general matrix soliton equations, which are of great importance for the foundations and the applications.Differential algebra (local conservation laws, Bäcklund-Darboux transforms), algebraic geometry (theta and Baker functions), and the inverse scattering method (Riemann-Hilbert problem) with well-grounded preliminaries are applied to various equations including principal chiral fields, Heisenberg magnets, Sin-Gordon, and Nonlinear Schrödinger equation.

Solitons were discovered by John Scott Russel in 1834, and have interested scientists and mathematicians ever since. They have been the subject of a large body of research in a wide variety of fields of physics and mathematics, not to mention engineering and other branches of science such as biology. This volume comprises the written versions of the talks presented at a workshop held at Queen's University in 1997, an interdisciplinary meeting wherein top researchers from many fields could meet, interact, and exchange ideas. Topics covered include mathematical and numerical aspects of solitons, as well as applications of solitons to nuclear and particle physics, cosmology, and condensed-matter physics. The book should be of interest to researchers in any field in which solitons are encountered.

Web-like waves, often observed on the surface of shallow water, are examples of nonlinear waves. They are generated by nonlinear

interactions among several obliquely propagating solitary waves, also known as solitons. In this book, modern mathematical tools—algebraic geometry, algebraic combinatorics, and representation theory, among others—are used to analyze these two-dimensional wave patterns. The author’s primary goal is to explain some details of the classification problem of the soliton solutions of the KP equation (or KP solitons) and their applications to shallow water waves. This book is intended for researchers and graduate students.
Nonl inear ideas of a "sol iton" variety have been a unifying influence on the na tura 1 sci ences for many decades. HO~/ever, thei r uni versa 1 a pprec i at i on in the physics community as a genuine paradigm is very much a current develop ment. All of us who have been associated with this recent wave of enthusiasm were impressed with the variety of applications, their inevitability once the mental contraint of linear normal modes is removed, and above all by the common mathematical structures underpinning applications with quite different (and often novel) physical manifestations. This has certainly been the situ ation in condensed matter, and when, during the Paris Lattice Dynamics Con ference (September 1977), one of us (T.S.) first suggested a condensed matter soliton Meeting, the idea was strongly encouraged. It would provide an opportunity to exhibit the common mathematical problems, illuminate the new contexts, and thereby focus the "subject" of nonlinear physics at this embryonic stage of its evolution. The original conception was to achieve a balance of mathematicians and phy~cis~ such that each would benefit from the other's expertise and out look. In contrast to many soliton Meetings, hO~/ever, a deliberate attempt was made to emphasize physics contexts rather than mathematical details.
The dominant medium for soliton propagation in electronics, nonlinear transmission line (NLTL) has found wide application as a testbed for nonlinear dynamics and KdV phenomena as well as for practical applications in ultra-sharp pulse/edge generation and novel nonlinear communication schemes in electronics. While many texts exist covering solitons in general, there is as yet no source that provides a comprehensive treatment of the soliton in the electrical domain. Drawing on the award winning research of Carnegie Mellon’s David S. Ricketts, Electrical Solitons Theory, Design, and Applications is the first text to focus specifically on KdV solitons in the nonlinear transmission line. Divided into three parts, the book begins with the foundational theory for KdV solitons, presents the core underlying mathematics of solitons, and describes the solution to the KdV equation and the basic properties of that solution, including collision behaviors and amplitude-dependent velocity. It also examines the conservation laws of the KdV for loss-less and lossy systems. The second part describes the KdV soliton in the context of the NLTL. It derives the lattice equation for solitons on the NLTL and shows the connection with the KdV equation as well as the governing equations for a lossy NLTL. Detailing the transformation between KdV theory and what we measure on the oscilloscope, the book demonstrates many of the key properties of solitons, including the inverse scattering method and soliton damping. The final part highlights practical applications such as sharp pulse formation and edge sharpening for high speed metrology as well as high frequency generation via NLTL harmonics. It describes challenges to realizing a robust soliton oscillator and the stability mechanisms necessary, and introduces three prototypes of the circular soliton oscillator using discrete and integrated platforms.