Nonlinear Waves in Elastic Media

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Michael Fey,Rolf Jeltsch

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   Nonlinear Waves in Elastic Media A.G. Kulikovskii,Elena I. Sveshnikova,2021-07-01 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   **Nonlinear Waves in Elastic Crystals** Gérard A. Maugin,1999 The mathematical modelling of changing structures in materials is of increasing importance to industry where applications of the theory are found in subjects as diverse as aerospace and medicine This book deals with aspects of the nonlinear dynamics of deformable ordered solids known as elastic crystals where the nonlinear effects combine or compete with each other Physical and mathematical models are discused and computational aspects are also included Different models are considered on discrete as well as continuum scales applying heat electricity or magnetism to the crystal structure and these are analysed using the equations of rational mechanics In this way the student is introduced to the important equations of nonlinear science that describe shock waves solitons and chaos and also the non exactly integrable systems or partial differential equations A large number of problems and examples are included many taken from recent research and involving both one dimensional and two dimensional problems as well as some coupled degress of freedom   **Selected Topics in Nonlinear Wave Mechanics** C.I. Christov,Arde Guran,2012-12-06 This book gives an overview ofthe current state of nonlinear wave mechanics with emphasis on strong discontinuities shock waves and localized self preserving shapes solitons in both elastic and fluid media The exposition is intentionallyat a detailed mathematical and physical level our expectation being that the reader will enjoy coming to grips in a concrete manner with advances in this fascinating subject Historically modern research in nonlinear wave mechanics began with the famous 1858 piston problem paper of Riemann on shock waves and con tinued into the early part of the last century with the work of Hadamard Rankine and Hugoniot After WWII research into nonlinear propagation of dispersive waves rapidly accelerated with the advent of computers Works of particular importance in the immediate post war years include those of von Neumann Fermi and Lax Later additional contributions were made by

Lighthill Glimm Strauss Wendroff and Bishop Dispersion alone leads to shock fronts of the propagating waves That the nonlinearity can com pensate for the dispersion leading to propagation with a stable wave having constant velocity and shape solitons came as a surprise A solitary wave was first discussed by J Scott Russell in 1845 in Report of British Asso ciations for the Advancement of Science He had while horseback riding observed a solitary wave travelling along a water channel and followed its unbroken progress for over a mile **Nonlinear Waves in Solids** A. Jeffrey,J. Engelbrecht,2014-05-04 Travelling wave processes and wave motion are of great importance in many areas of mechanics and nonlinearity also plays a decisive role there The basic mathematical models in this area involve nonlinear partial differential equations and predictability of behaviour of wave phenomena is of great importance Beside fluid dynamics and gas dynamics which have long been the traditional nonlinear scienes solid mechanics is now taking an ever increasing account of nonlinear effects Apart from plasticity and fracture mechanics nonlinear elastic waves have been shown to be of great importance in many areas such as the study of impact nondestructive testing and seismology These lectures offer a thorough account of the fundamental theory of nonlinear deformation waves and in the process offer an up to date account of the current state of research in the theory and practice of nonlinear waves in solids Linear and Nonlinear Waves in Microstructured Solids Igor V. Andrianov,Jan Awrejcewicz,Vladyslav Danishevskyy,2021-04-22 This book uses asymptotic methods to obtain simple approximate analytic solutions to various problems within mechanics notably wave processes in heterogeneous materials Presenting original solutions to common issues within mechanics this book builds upon years of research to demonstrate the benefits of implementing asymptotic techniques within mechanical engineering and material science Focusing on linear and nonlinear wave phenomena in complex micro structured solids the book determines their global characteristics through analysis of their internal structure using homogenization and asymptotic procedures in line with the latest thinking within the field The book s cutting edge methodology can be applied to optimal design non destructive control and in deep seismic sounding providing a valuable alternative to widely used numerical methods Using case studies the book covers topics such as elastic waves in nonhomogeneous materials regular and chaotic dynamics based on continualisation and discretization and vibration localization in 1D Linear and Nonlinear lattices The book will be of interest to students research engineers and professionals specialising in mathematics and physics as well as mechanical and civil engineering *Wave Processes in Solids with Microstructure* Vladimir I. Erofeyev,2003 1 The fundamental hypothesis of microstructured elastic solids Structural phenomenological model 1 1 Mathematical models of solids with microstructure 1 2 Definition of material constants 2 Gradient elasticity media Dispersion Dissipation Non linearity 2 1 Dynamic equations Energy and momentum variation law 2 2 Dispersion properties of longitudinal and shear waves Surface Rayleigh waves 2 3 Dissipative properties 2 4 Nonlinear plain stationary waves 2 5 Quasi plain wave beams 2 6 Self modulation of quasi harmonic shear waves 2 7 Resonant interaction of quasi harmonic waves 2 8 Noise waves 3 Gradient elasticity media Damaged medium

Magnetoelasticity 3 1 Waves in damaged medium with microstructure 3 2 Magneto elastic waves in the medium with microstructure 4 Cosserat continuum 4 1 Basic equations of micropolar elasticity theory 4 2 Dispersion properties of volume waves 4 3 Wave reflection from the free interface of micropolar halfspace Rayleigh surface waves 4 4 Normal waves in a micropolar layer 4 5 Nonlinear resonant interaction of longitudinal and rotation waves 4 6 Waves in Cosserat pseudocontinuum 4 7 Waves in the Cosserat continuum with symmetric stress tensor 5 Waves in two component mixture of solids 5 1 Dispersion properties 5 2 Some nonlinear wave effects 6 Waves in micromorphic solids 6 1 Dynamics equations 6 2 Different types of volume waves and their dispersion properties 6 3 Surface shear waves in the gradient elastic half space with surface energy 7 Elasto plastic waves in the medium with dislocations 7 1 Equations of dynamics 7 2 Dispersion properties 7 3 Some nonlinear problems 7 4 Correlation of elasto plastic continuum and Cosserat continuum 7 5 Example of research of the influence of dislocations on dispersion and damping of ultrasound in solid body 8 Wave problems of micropolar hydrodynamics 8 1 Rotational waves in micropolar liquids 8 2 Shear surface wave at the interface of elastic body and micropolar liquid 8 3 Shear surface wave at the interface between elastic half space and conducting viscous liquid in a magnetic field **Nonlinear Waves in Inhomogeneous and Hereditary Media** Aleksandr Aleksandrovich Lokshin,Elena Arturovna Sagomoni︠a︡n,1992 <u>Applied Mechanics Reviews</u> ,1974 <u>Wavelet and Wave Analysis as Applied to Materials with Micro Or Nanostructure</u> Carlo Cattani,2007 This seminal book unites three different areas of modern science the micromechanics and nanomechanics of composite materials wavelet analysis as applied to physical problems and the propagation of a new type of solitary wave in composite materials nonlinear waves Each of the three areas is described in a simple and understandable form focusing on the many perspectives of the links among the three All of the techniques and procedures are described here in the clearest and most open form enabling the reader to quickly learn and use them when faced with the new and more advanced problems that are proposed in this book By combining these new scientific concepts into a unitary model and enlightening readers on this pioneering field of research readers will hopefully be inspired to explore the more advanced aspects of this promising scientific direction The application of wavelet analysis to nanomaterials and waves in nanocomposites can be very appealing to both specialists working on theoretical developments in wavelets as well as specialists applying these methods and experiments in the mechanics of materials Sample Chapter s Chapter 1 Introduction 121 KB Contents Wavelet Analysis Materials with Micro or Nanostructure Waves in Materials Simple and Solitary Waves in Materials Solitary Waves and Elastic Waves Readership Advanced undergraduate and graduate students as well as experts in mathematical modeling engineering mechanics and mechanics physics specialists in wavelet and wave analysis as tools for mathematical modeling <u>Sound Topology, Duality, Coherence and Wave-Mixing</u> Pierre Deymier,Keith Runge,2017-08-12 This book offers an essential introduction to the notions of sound wave topology duality coherence and wave mixing which constitute the emerging new science of sound It includes general principles and specific examples that

illuminate new non conventional forms of sound sound topology unconventional quantum like behavior of phonons duality radical linear and nonlinear phenomena associated with loss and its control coherence and exquisite effects that emerge from the interaction of sound with other physical and biological waves wave mixing The book provides the reader with the foundations needed to master these complex notions through simple yet meaningful examples General principles for unraveling and describing the topology of acoustic wave functions in the space of their Eigen values are presented These principles are then applied to uncover intrinsic and extrinsic approaches to achieving non conventional topologies by breaking the time reversal symmetry of acoustic waves Symmetry breaking can impart topological immunity to wave degradation from imperfection scattering and catalyze controlled coherence In the intrinsic case and the phonon representation of acoustic waves the self interaction interference of a wave through its supporting medium exposes the notion of duality in the quantum statistics i e boson vs fermion characterized by the symmetry of multiple particle states and how the quantum analogue behaviors of sound can be exploited in the form of novel sound based information transfer and processing devices By considering media that mix different types of waves the book addresses the interaction of sound with other physical and biological waves but also brings to light examples of extrinsic processes that can lead to symmetry breaking The coherent conversion of sound into other types of waves as well as the sound induced non conventional topology of elastic electronic spin and biological waves are presented in the case of media exhibiting elasto electronic photo elastic magneto elastic effects and biological mechano transduction   *Nonlinear Wave Dynamics of Materials and Structures* Holm Altenbach,Victor A. Eremeyev,Igor S. Pavlov,Alexey V. Porubov,2020-04-22 This book marks the 60th birthday of Prof Vladimir Erofeev a well known specialist in the field of wave processes in solids fluids and structures Featuring a collection of papers related to Prof Erofeev s contributions in the field it presents articles on the current problems concerning the theory of nonlinear wave processes in generalized continua and structures It also discusses a number of applications as well as various discrete and continuous dynamic models of structures and media and problems of nonlinear acoustic diagnostics
      Strain Solitons in Solids and How to Construct Them Alexander M. Samsonov,2001-01-18 Although the theory behind solitary waves of strain shows that they hold significant promise in nondestructive testing and a variety of other applications an enigma has long persisted the absence of observable elastic solitary waves in practice Inspired by this apparent contradiction Strain Solitons in Solids and How to Construct Them refines th   **Introduction to Petroleum Seismology, second edition** Luc T. Ikelle ,Lasse Amundsen,2018-03-26 Introduction to Petroleum Seismology second edition SEG Investigations in Geophysics Series No 12 provides the theoretical and practical foundation for tackling present and future challenges of petroleum seismology especially those related to seismic survey designs seismic data acquisition seismic and EM modeling seismic imaging microseismicity and reservoir characterization and monitoring All of the chapters from the first edition have been improved and or expanded In addition twelve new chapters have been added These new chapters

expand topics which were only alluded to in the first edition sparsity representation sparsity and nonlinear optimization near simultaneous multiple shooting acquisition and processing nonuniform wavefield sampling automated modeling elastic electromagnetic mathematical equivalences and microseismicity in the context of hydraulic fracturing Another major modification in this edition is that each chapter contains analytical problems as well as computational problems These problems include MatLab codes which may help readers improve their understanding of and intuition about these materials The comprehensiveness of this book makes it a suitable text for undergraduate and graduate courses that target geophysicists and engineers as well as a guide and reference work for researchers and professionals in academia and in the petroleum industry   Hyperbolic Problems: Theory, Numerics, Applications Michael Fey,Rolf Jeltsch,2012-12-06 Infotext Kurztext These are the proceedings of the 7th International Conference on Hyperbolic Problems held in Z rich in February 1998 The speakers and contributors have been rigorously selected and present the state of the art in this field The articles both theoretical and numerical encompass a wide range of applications such as nonlinear waves in solids various computational fluid dynamics from small scale combustion to relativistic astrophysical problems multiphase phenomena and geometrical optics Volltext These proceedings contain in two volumes approximately one hundred papers presented at the conference on hyperbolic problems which has focused to a large extent on the laws of nonlinear hyperbolic conservation Two fifths of the papers are devoted to mathematical aspects such as global existence uniqueness asymptotic behavior such as large time stability stability and instabilities of waves and structures various limits of the solution the Riemann problem and so on Roughly the same number of articles are devoted to numerical analysis for example stability and convergence of numerical schemes as well as schemes with special desired properties such as shock capturing interface fitting and high order approximations to multidimensional systems The results in these contributions both theoretical and numerical encompass a wide range of applications such as nonlinear waves in solids various computational fluid dynamics from small scale combustion to relativistic astrophysical problems multiphase phenomena and geometrical optics   Wave Momentum And Quasi-particles In Physical Acoustics Gerard A Maugin,Martine Rousseau,2015-03-26 This unique volume presents an original approach to physical acoustics with additional emphasis on the most useful surface acoustic waves on solids The study is based on foundational work of L on Brillouin and application of the celebrated invariance theorem of Emmy Noether to an element of volume that is representative of the wave motion This approach provides an easy interpretation of typical wave motions of physical acoustics in bulk at surfaces and across interfaces in the form of the motion of associated quasi particles This type of motion Newtonian or not depends on the wave motion considered and on the original modeling of the continuum that supports it After a thoughtful review of Brillouin s fundamental ideas related to radiative stresses wave momentum and action and the necessary reminder on modern nonlinear continuum thermomechanics invariance theory and techniques of asymptotics a variety of situations and models illustrates the power and richness of the approach and its strong

potential in applications Elasticity piezoelectricity and new models of continua with nonlinearity viscosity and some generalized features microstructure weak or strong nonlocality or unusual situations bounding surface with energy elastic thin film glued on a surface waveguide are considered exhibiting thus the versatility of the approach This original book offers an innovative vision and treatment of the problems of wave propagation in deformable solids It opens up new horizons in the theoretical and applied facets of physical acoustics **Questions About Elastic Waves** Jüri Engelbrecht,2015-03-05 This book addresses the modelling of mechanical waves by asking the right questions about them and trying to find suitable answers The questions follow the analytical sequence from elementary understandings to complicated cases following a step by step path towards increased knowledge The focus is on waves in elastic solids although some examples also concern non conservative cases for the sake of completeness Special attention is paid to the understanding of the influence of microstructure nonlinearity and internal variables in continua With the help of many mathematical models for describing waves physical phenomena concerning wave dispersion nonlinear effects emergence of solitary waves scales and hierarchies of waves as well as the governing physical parameters are analysed Also the energy balance in waves and non conservative models with energy influx are discussed Finally all answers are interwoven into the canvas of complexity **Mathematical Aspects of Numerical Solution of Hyperbolic Systems** A.G. Kulikovskii,N.V. Pogorelov,A. Yu. Semenov,2000-12-21 This important new book sets forth a comprehensive description of various mathematical aspects of problems originating in numerical solution of hyperbolic systems of partial differential equations The authors present the material in the context of the important mechanical applications of such systems including the Euler equations of gas dynamics magnetohydrodynamics MHD shallow water and solid dynamics equations This treatment provides for the first time in book form a collection of recipes for applying higher order non oscillatory shock capturing schemes to MHD modelling of physical phenomena The authors also address a number of original nonclassical problems such as shock wave propagation in rods and composite materials ionization fronts in plasma and electromagnetic shock waves in magnets They show that if a small scale higher order mathematical model results in oscillations of the discontinuity structure the variety of admissible discontinuities can exhibit disperse behavior including some with additional boundary conditions that do not follow from the hyperbolic conservation laws Nonclassical problems are accompanied by a multiple nonuniqueness of solutions The authors formulate several selection rules which in some cases easily allow a correct physically realizable choice This work systematizes methods for overcoming the difficulties inherent in the solution of hyperbolic systems Its unique focus on applications both traditional and new makes Mathematical Aspects of Numerical Solution of Hyperbolic Systems particularly valuable not only to those interested the development of numerical methods but to physicists and engineers who strive to solve increasingly complicated nonlinear equations *AI for Rock Dynamics* Manchao He,LiGe Wang,Wei Yao,Wengang Dang,Zhuo Wang,2025-07-18 This Open Access book covers various aspects in rock dynamics comprehensively such as theoretical

foundations testing techniques dynamic properties stress wave propagation rockburst dynamics numerical simulation and engineering applications AI for Rock Dynamics is a groundbreaking Open Access monograph that redefines publishing through Luffa AI a China developed large language model LLM Set to captivate at the London Book Fair 2025 it marks a transformative milestone in rock mechanics and beyond Covering theoretical foundations testing instruments numerical simulation and engineering applications it s an essential resource for professionals in civil engineering mining and geology alike Its clear presentation illustrations and practical insights make it pivotal for tackling rock mechanics challenges Unique for its homegrown LLM it showcases Chinese AI s potential to advance research As China s first LLM powered book it revolutionizes knowledge production organization and dissemination This landmark was achieved through a strategic partnership between CNPIEC Kexin Technology CSRME and Springer Nature unprecedentedly integrating cutting edge technology academic expertise and global publishing prominence Published as Open Access it democratizes knowledge fostering collaboration and innovation The first of its kind signifies AI s potential to transform publishing streamlining content creation and enhancing dissemination AI for Rock Dynamics is a beacon of progress uniting technology and academia to push knowledge boundaries with concerted efforts Please Join us in celebrating this historic achievement and witness the dawn of AI powered publishing   *Acoustic Interactions with Submerged Elastic Structures: Propagation, ocean acoustics, and scattering : a Herbert ⵏberall festschrift volume* Ard⵿shir Guran,Herbert ⵏberall,1996 The interaction of acoustic fields with submerged elastic structures both by propagation and scattering is being investigated at various institutions and laboratories world wide with ever increasing sophistication of experiments and analysis This book offers a collection of contributions from these research centers that represent the present state of the art in the study of acoustic elastic interaction being on the cutting edge of these investigations This includes the description of acoustic scattering from submerged elastic objects and shells by the Resonance Scattering Theory of Flax Dragonette and berall and the interaction of these phenomena in terms of interface waves It also includes the use of this theory for the purpose of inverse scattering i e the determination of the scattered objects properties from the received acoustic backscattered signals The problem of acoustically excited waves in inhomogeneous and anisotropic materials and of inhomogeneous propagating waves is considered Vibrations and resonances of elastic shells including shells with various kinds of internal attachments are analyzed Acoustic scattering experiments are described in the time domain and on the basis of the Wigner Ville distribution Acoustic propagation in the water column over elastic boundaries is studied experimentally both in laboratory tanks and in the field and is analyzed theoretically Ultrasonic nondestructive testing including such aspects like probe modelling scattering by various types of cracks receiving probes and calibration by a side drilled hole is also studied in details A comprehensive picture of these complex phenomena and other aspects is presented in the book by researchers that are experts in each of these domains giving up to date accounts of the field in all these aspects   **Proceedings of the**

Estonian Academy of Sciences, Engineering ,2000-09

Nonlinear Waves In Elastic Media: Bestsellers in 2023 The year 2023 has witnessed a noteworthy surge in literary brilliance, with numerous captivating novels enthralling the hearts of readers worldwide. Lets delve into the realm of popular books, exploring the fascinating narratives that have captivated audiences this year. Nonlinear Waves In Elastic Media : Colleen Hoovers "It Ends with Us" This heartfelt tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover masterfully weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can triumph. Uncover the Best : Taylor Jenkins Reids "The Seven Husbands of Evelyn Hugo" This captivating historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reids absorbing storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Discover the Magic : Delia Owens "Where the Crawdads Sing" This evocative coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens crafts a tale of resilience, survival, and the transformative power of nature, entrancing readers with its evocative prose and mesmerizing setting. These bestselling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of engaging stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a masterful and gripping novel that will keep you wondering until the very end. The novel is a warning tale about the dangers of obsession and the power of evil.

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Nonlinear Waves In Elastic Media Introduction

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