# JULIAN L. DAVIS

# WAVE

## MATHEMATICS OF

## PROPAGATION

# Mathematics Of Wave Propagation

**Tomáš Bodnár,Giovanni P. Galdi,Šárka Nečasová**

**Mathematics Of Wave Propagation:**

Mathematics of Wave Propagation Julian L. Davis,2000-05-07 Earthquakes a plucked string ocean waves crashing on the beach the sound waves that allow us to recognize known voices Waves are everywhere and the propagation and classical properties of these apparently disparate phenomena can be described by the same mathematical methods variational calculus characteristics theory and caustics Taking a medium by medium approach Julian Davis explains the mathematics needed to understand wave propagation in inviscid and viscous fluids elastic solids viscoelastic solids and thermoelastic media including hyperbolic partial differential equations and characteristics theory which makes possible geometric solutions to nonlinear wave problems The result is a clear and unified treatment of wave propagation that makes a diverse body of mathematics accessible to engineers physicists and applied mathematicians engaged in research on elasticity aerodynamics and fluid mechanics This book will particularly appeal to those working across specializations and those who seek the truly interdisciplinary understanding necessary to fully grasp waves and their behavior By proceeding from concrete phenomena e g the Doppler effect the motion of sinusoidal waves energy dissipation in viscous fluids thermal stress rather than abstract mathematical principles Davis also creates a one stop reference that will be prized by students of continuum mechanics and by mathematicians needing information on the physics of waves *Waves in Continuous Media* S. L. Gavrilyuk,N.I. Makarenko,S.V. Sukhinin,2017-01-27 Starting with the basic notions and facts of the mathematical theory of waves illustrated by numerous examples exercises and methods of solving typical problems Chapters 1 2 show e g how to recognize the hyperbolicity property find characteristics Riemann invariants and conservation laws for quasilinear systems of equations construct and analyze solutions with weak or strong discontinuities and how to investigate equations with dispersion and to construct travelling wave solutions for models reducible to nonlinear evolution equations Chapter 3 deals with surface and internal waves in an incompressible fluid The efficiency of mathematical methods is demonstrated on a hierarchy of approximate submodels generated from the Euler equations of homogeneous and non homogeneous fluids The self contained presentations of the material is complemented by 200 problems of different level of difficulty numerous illustrations and bibliographical recommendations **Mathematical and Numerical Aspects of Wave Propagation WAVES 2003** Gary Cohen,Erkki Heikkola,Patrick Joly,Pekka Neittaanmäki,2012-12-06 This volume includes articles on the mathematical modeling and numerical simulation of various wave phenomena For many years Waves 2003 and its five prior conferences have been an important forum for discussions on wave propagation The topic is equally important for fundamental sciences engineering mathematics and in particular for industrial applications Areas of specific interest are acoustics electromagnetics elasticity and related inverse and optimization problems This book gives an extensive overview of recent developments in a very active field of scientific computing Mathematical methods for wave propagation in science and engineering Mario Durán,2017 This series of books deals with the mathematical modeling and computational simulation of

complex wave propagation phenomena in science and engineering This first volume of the series introduces the basic mathematical and physical fundamentals and it is mainly intended as a reference guide and a general survey for scientists and engineers It presents a broad and practical overview of the involved foundations being useful as much in industrial research development and innovation activities as in academic labors   Lectures on Wave Propagation Gerald Beresford Whitham,1979   **Wave Propagation** Peter Markos,Costas M. Soukoulis,2008-04-01 This textbook offers the first unified treatment of wave propagation in electronic and electromagnetic systems and introduces readers to the essentials of the transfer matrix method a powerful analytical tool that can be used to model and study an array of problems pertaining to wave propagation in electrons and photons It is aimed at graduate and advanced undergraduate students in physics materials science electrical and computer engineering and mathematics and is ideal for researchers in photonic crystals negative index materials left handed materials plasmonics nonlinear effects and optics Peter Markos and Costas Soukoulis begin by establishing the analogy between wave propagation in electronic systems and electromagnetic media and then show how the transfer matrix can be easily applied to any type of wave propagation such as electromagnetic acoustic and elastic waves The transfer matrix approach of the tight binding model allows readers to understand its implementation quickly and all the concepts of solid state physics are clearly introduced Markos and Soukoulis then build the discussion of such topics as random systems and localized and delocalized modes around the transfer matrix bringing remarkable clarity to the subject Total internal reflection Brewster angles evanescent waves surface waves and resonant tunneling in left handed materials are introduced and treated in detail as are important new developments like photonic crystals negative index materials and surface plasmons Problem sets aid students working through the subject for the first time   *Topics in Computational Wave Propagation* Mark Ainsworth,Penny Davies,Dugald B. Duncan,Paul A Martin,Bryan Rynne,2003-08-27 These ten detailed and authoritative survey articles on numerical methods for direct and inverse wave propagation problems are written by leading experts Researchers and practitioners in computational wave propagation from postgraduate level onwards will find the breadth and depth of coverage of recent developments a valuable resource The articles describe a wide range of topics on the application and analysis of methods for time and frequency domain PDE and boundary integral formulations of wave propagation problems Electromagnetic seismic and acoustic equations are considered Recent developments in methods and analysis ranging from finite differences to hp adaptive finite elements including high accuracy and fast methods are described with extensive references   **Mathematical Problems in Wave Propagation Theory** V. M. Babich,1970

  Inverse Problems in Wave Propagation Guy Chavent,George Papanicolaou,Paul Sacks,William Symes,2012-12-06 Inverse problems in wave propagation concern extraction of information about distant structural features from the measurements of scattered waves Tasks of this nature arise in geophysics ocean acoustics civil and environmental engineering ultrasonic nondestructive testing biomedical ultrasonics radar astrophysics and other areas of science and technology The papers in

this volume represent most of these scientific and technical topics together with fundamental mathematical investigations of the relation between waves and scatterers     **Third International Conference on Mathematical and Numerical Aspects of Wave Propagation** Gary C. Cohen,1995-01-01 This volume contains the papers presented at the title conference Speakers from 13 different countries were represented at the meeting A broad range of topics in theoretical and applied wave propagation is covered     Wave Propagation in Elastic Solids Jan Achenbach,2012-12-02 The propagation of mechanical disturbances in solids is of interest in many branches of the physical scienses and engineering This book aims to present an account of the theory of wave propagation in elastic solids The material is arranged to present an exposition of the basic concepts of mechanical wave propagation within a one dimensional setting and a discussion of formal aspects of elastodynamic theory in three dimensions followed by chapters expounding on typical wave propagation phenomena such as radiation reflection refraction propagation in waveguides and diffraction The treatment necessarily involves considerable mathematical analysis The pertinent mathematical techniques are however discussed at some length     Direct and Inverse Problems in Wave Propagation and Applications Ivan Graham,Ulrich Langer,Jens Melenk,Mourad Sini,2013-10-14 This book is the third volume of three volume series recording the Radon Special Semester 2011 on Multiscale Simulation Analysis in Energy and the Environment taking place in Linz Austria October 3 7 2011 This book surveys recent developments in the analysis of wave propagation problems The topics covered include aspects of the forward problem and problems in inverse problems as well as applications in the earth sciences Wave propagation problems are ubiquitous in environmental applications such as seismic analysis acoustic and electromagnetic scattering The design of efficient numerical methods for the forward problem in which the scattered field is computed from known geometric configurations is very challenging due to the multiscale nature of the problems Even more challenging are inverse problems where material parameters and configurations have to be determined from measurements in conjunction with the forward problem This book contains review articles covering several state of the art numerical methods for both forward and inverse problems This collection of survey articles focusses on the efficient computation of wave propagation and scattering is a core problem in numerical mathematics which is currently of great research interest and is central to many applications in energy and the environment Two generic applications which resonate strongly with the central aims of the Radon Special Semester 2011 are forward wave propagation in heterogeneous media and seismic inversion for subsurface imaging As an example of the first application modelling of absorption and scattering of radiation by clouds aerosol and precipitation is used as a tool for interpretation of e g solar infrared and radar measurements and as a component in larger weather climate prediction models in numerical weather forecasting As an example of the second application inverse problems in wave propagation in heterogeneous media arise in the problem of imaging the subsurface below land or marine deposits The book records the achievements of Workshop 3 Wave Propagation and Scattering Inverse Problems and Applications in Energy and the Environment It brings

together key numerical mathematicians whose interest is in the analysis and computation of wave propagation and scattering problems and in inverse problems together with practitioners from engineering and industry whose interest is in the applications of these core problems    **Wave Phenomena** Lui Lam,Hedley C. Morris,2012-12-06 IJ 1 June of 1987 the Center for Applied Mathematics and Computer Science at San Jose State University received a bequest of over half a million dollars from the estate of Mrs Marie Woodward In the opening article of this collection of papers Jane Day the founder of the Center describes the background that led to this gift In recognition of the bequest it was decided that a series of Woodward Conferences be established The First Woodward Conference took place at San Jose State University on June 2 3 1988 The themes of the conference were the Theoretical Computational and Practical Aspects of Wave Phenomena and these same themes have been used to divide the contributions to this volume Part I is concerned with papers on theoretical aspects This section includes papers on pseudo differential operator techniques inverse problems and the mathematical foundations of wave propagation in random media Part II consists of papers that involve significant amounts of computation Included are papers on the Fast Hartley Transform computational algorithms for electromagnetic scattering problems and nonlinear wave interaction problems in fluid mechanics vi Part III contains papers with a genuine physics flavor This final section illustrates the widespread importance of wave phenomena in physics Among the phenomena considered are waves in the atmosphere viscous fingering in liquid crystals solitons and wave localization    *Wave Propagation* Giorgio Ferrarese,2011-03-30

   *Analytical and Numerical Methods for Wave Propagation in Fluid Media* K. Murawski,2002 This book surveys analytical and numerical techniques appropriate to the description of fluid motion with an emphasis on the most widely used techniques exhibiting the best performance Analytical and numerical solutions to hyperbolic systems of wave equations are the primary focus of the book In addition many interesting wave phenomena in fluids are considered using examples such as acoustic waves the emission of air pollutants magnetohydrodynamic waves in the solar corona solar wind interaction with the planet venus and ion acoustic solitons    **Waves in Flows** Tomáš Bodnár,Giovanni P. Galdi,Šárka Nečasová,2021-04-29 This volume offers an overview of the area of waves in fluids and the role they play in the mathematical analysis and numerical simulation of fluid flows Based on lectures given at the summer school Waves in Flows held in Prague from August 27 31 2018 chapters are written by renowned experts in their respective fields Featuring an accessible and flexible presentation readers will be motivated to broaden their perspectives on the interconnectedness of mathematics and physics A wide range of topics are presented working from mathematical modelling to environmental biomedical and industrial applications Specific topics covered include Equatorial wave current interactions Water wave problems Gravity wave propagation Flow acoustic interactions Waves in Flows will appeal to graduate students and researchers in both mathematics and physics Because of the applications presented it will also be of interest to engineers working on environmental and industrial issues    **Stochastic Wave Propagation** K. Sobczyk,2012-12-02 This is a concise unified exposition of the existing methods of

analysis of linear stochastic waves with particular reference to the most recent results Both scalar and vector waves are considered Principal attention is concentrated on wave propagation in stochastic media and wave scattering at stochastic surfaces However discussion extends also to various mathematical aspects of stochastic wave equations and problems of modelling stochastic media      Mathematical Studies in Nonlinear Wave Propagation Dominic P. Clemence,Guoqing Tang,2005-07-05 Lively discussions and stimulating research were part of a five day conference on Mathematical Methods in Nonlinear Wave Propagation sponsored by the NSF and CBMS This volume is a collection of lectures and papers stemming from that event Leading experts present dynamical systems and chaos scattering and spectral theory nonlinear wave equations optimal control optical waveguide design and numerical simulation The book is suitable for a diverse audience of mathematical specialists interested in fiber optic communications and other nonlinear phenomena It is also suitable for engineers and other scientists interested in the mathematics of nonlinear wave propagation      **Linear And Nonlinear Wave Propagation** Spencer P Kuo,2021-04-16 Waves are essential phenomena in most scientific and engineering disciplines such as electromagnetism and optics and different mechanics including fluid solid structural quantum etc They appear in linear and nonlinear systems Some can be observed directly and others are not The features of the waves are usually described by solutions to either linear or nonlinear partial differential equations which are fundamental to the students and researchers Generic equations describing wave and pulse propagation in linear and nonlinear systems are introduced and analyzed as initial boundary value problems These systems cover the general properties of non dispersive and dispersive uniform and non uniform with without dissipations Methods of analyses are introduced and illustrated with analytical solutions Wave wave and wave particle interactions ascribed to the nonlinearity of media such as plasma are discussed in the final chapter This interdisciplinary textbook is essential reading for anyone in above mentioned disciplines It was prepared to provide students with an understanding of waves and methods of solving wave propagation problems The presentation is self contained and should be read without difficulty by those who have adequate preparation in classic mechanics The selection of topics and the focus given to each provide essential materials for a lecturer to cover the bases in a linear nonlinear wave course      Mathematical Modelling of Waves in Multi-Scale Structured Media Alexander B. Movchan,Natasha V. Movchan,Ian S. Jones,Daniel J. Colquitt,2017-11-09 Mathematical Modelling of Waves in Multi Scale Structured Media presents novel analytical and numerical models of waves in structured elastic media with emphasis on the asymptotic analysis of phenomena such as dynamic anisotropy localisation filtering and polarisation as well as on the modelling of photonic phononic and platonic crystals

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