Acoustic And Electromagnetic Equations Integral Representations For Harmonic Problems Applied Mathematical Sciences

The book contains a selection of high quality papers, chosen among the best presentations during the International Conference on Spectral and High-Order Methods (2012), and provides an overview of the depth and breath of the activities within this important research area. The carefully reviewed selection of the papers will provide the reader with a snapshot of state-of-the-art and help initiate new research directions through the extensive bibliography. ?

It has now been almost ten years since our first book on scattering theory ap peared [32]. At that time we claimed that "in recent years the development of integral equation methods for the direct scattering problem seems to be nearing completion, whereas the use of such an approach to study the inverse scattering problem has progressed to an extent that a 'state of the art' survey appears highly desirable". Since we wrote these words, the inverse scattering problem for acoustic and electromagnetic waves has grown from being a few theoreti cal considerations with limited numerical implementations to a weH developed mathematical theory with tested numerical algorithms. This maturing of the field of inverse scattering theory has been based on the realization that such problems are in general not only nonlinear but also improperly posed in the sense that the solution does not depend continuously on the measured data. This was emphasized in [32] and treated with the ideas and tools available at that time. Now, almost ten years later, these initial ideas have developed to the extent that a monograph summarizing the mathematical basis of the field seems appropriate. This book is oUf attempt to write such a monograph. The inverse scattering problem for acoustic and electromagnetic waves can broadly be divided into two classes, the inverse obstacle problem and the inverse medium problem.

This book is a collection of short papers from the 11th International ISAAC Congress 2017 in Växjö, Sweden. The papers, written by the best international experts, are devoted to recent results in mathematics with a focus on analysis. The volume provides to both specialists and non-specialists an excellent source of information on the current research in mathematical analysis and its various interdisciplinary applications.

Super-Resolution imaging refers to modern techniques of achieving resolution below conventional limits. This book gives a comprehensive overview of mathematical and computational techniques used to achieve this, providing a solid foundation on which to develop the knowledge and skills needed for practical application of techniques. Split into five parts, the first looks at the mathematical and probabilistic tools needed, before moving on to description of different types of imaging; single-wave, anomaly, multi-wave and spectroscopic and nanoparticle. As an important contribution to the understanding of super-resolution techniques in biomedical imaging, this book is a useful resource for scientists and engineers in the fields of biomedical imaging and super-resolution, and is self-contained reference for any newcomers to these fields.

Proceedings of a Symposium

With Applications to Inverse Problems and Effective Medium Theory

Integral Equation Methods in Scattering Theory

Time Domain Boundary Integral Equation Methods in Acoustics, Heat Diffusion and Electromagnetism

Inverse Acoustic and Electromagnetic Scattering Theory

Acoustic and Electromagnetic Scattering Analysis Using Discrete Sources

The discrete sources method is an efficient and powerful tool for solving a large class of boundary-value problems in scattering theory. A variety of numerical methods for discrete sources now exist. In this book, the authors unify these formulations in the context of the so-called discrete sources method. Comprehensive presentation of the discrete sources method Original theory - an extension of the conventional null-field method using discrete sources Practical examples that demonstrate the efficiency and flexibility of elaborated methods (scattering by particles with high aspect ratio, rough particles, nonaxisymmetric particles, multiple scattering) List of discrete sources programmes available via the Internet

The first book of its kind to cover a wide range of computational methods for electromagnetic phenomena, from atomistic to continuum scales, this integrated and balanced treatment of mathematical formulations, algorithms and the underlying physics enables us to engage in innovative and advanced interdisciplinary computational research.

This book focuses on computational methods to determine the dynamics of large-scale electromagnetic, acoustic, and mechanical systems, including those with many substructures and characterized by an extended range of scales. Examples include large naval and maritime vessels, aerospace vehicles, and densely packed microelectronic and optical integrated circuits (VLSI). The interplay of time and frequency-domain computational and experimental procedures was addressed, emphasizing their relationship and synergy, and indicating mathematics research opportunities.

This thesis analyzes the discretization error induced by the Convolution Quadrature Galerkin method in seeking the numerical solution to time domain boundary integral equations arising in the problem of acoustic wave scattering by penetrable obstacles, electromagnetic wave scattering by a perfect electric conductor and heat conduction in the presence of a bounded inclusion. There are two sources of the numerical error: the error between the exact solution and spatial semidiscrete solution, and the error between the spatial semidiscrete solution and fully discrete solution. In the spatial semidiscrete error analysis, we fit the problem into the framework of the strongly continuous semigroup theory and obtain an error estimate sharper than that attainable by the traditional Laplace domain approach. For the full discrete error analysis, we try to apply the functional calculus theory to achieve a pure time domain approach with some success. Several numerical experiments are provided to validate the theoretical results.

Dynamics of Evolutionary Equations

Electromagnetic and Acoustic Scattering: Detection and Inverse Problems

Low Frequency Acoustic and Electromagnetic Scattering

An Introduction with Applications to PDEs

Spectral and High Order Methods for Partial Differential Equations - ICOSAHOM 2012

A Volume Dedicated to Jean-Claude Nédélec

The theory and applications of infinite dimensional dynamical systems have attracted the attention of scientists for quite some time. This book serves as an entrée for scholars beginning their journey into the world of dynamical systems, especially infinite dimensional spaces. The main approach involves the theory of evolutionary equations.

This book highlights new developments in the wide and growing field of partial differential equations (PDE)-constrained optimization. Optimization problems where the dynamics evolve according to a system of PDEs arise in science, engineering, and economic applications and they can take the form of inverse problems, optimal control problems or optimal design problems. This book covers new theoretical, computational as well as implementation aspects for PDE-constrained optimization problems under uncertainty, in shape optimization, and in feedback control, and it illustrates the new developments on representative problems from a variety of applications.

This volume takes up various topics in Mathematical Analysis including boundary and initial value problems for Partial Differential Equations and Functional Analytic methods. Topics include linear elliptic systems for composite material — the coefficients may jump from domain to domain; Stochastic Analysis — many applied problems involve evolution equations with random terms, leading to the use of stochastic analysis. The proceedings have been selected for coverage in: • Index to Scientific & Technical Proceedings (ISTP CDROM version / ISI Proceedings) • CC Proceedings — Engineering & Physical Sciences Contents:Deterministic Analysis:Differentiation of Hypergeometric Functions with Respect to Parameters (Yu A Brychkov & K O Geddes)On the Lagrange Problem About the Strongest Columns (Yu V Egorov)Wavelet Based Fast Solution of Boundary Integral Equations (H Harbrecht & R Schneider)Semi-Classical Methods in Ginzburg–Landau Theory (B Helffer)Stability of Equilibriums in One-Dimensional Motion of Compressible Viscous Gas Forced by Self-Gravity (Y Iwata & Y Yamamoto)Estimates for Elliptic Systems for Composite Material (L Nirenberg)On Asymptotics for the Mabuchi Energy Functional (D H Phong & J Sturm)Regularity of Solutions of the Initial Boundary Value Problem for Linearized Equations of Ideal Magneto-Hydrodynamics (M Yamamoto)Stochastic Analysis:Impulsive Stochastic Evolution Inclusions with Multi-Valued Diffusion (N U Ahmed)Some of Future Directions of White Noise Analysis (T Hida)Constructing Random Probability Distributions (T P Hill & D E R Sitton)Multiparameter Additive Processes of Mixture Type (K Inoue)The Random Integral Representation Hypothesis Revisited: New Classes of S-Selfdecomposable Laws (Z J Jurek)Semigroups and Processes with Parameter in a Cone (J Pedersen & K-I Sato)and other papers Readership: Researchers and academics in the fields of analysis and differential equations, approximation theory, probability and statistics. Keywords:Almost Complex Manifolds;Noncommutative Geometry;Lagrange Problem;Boundary Value Problem

Acoustic and electromagnetic waves underlie a vast range of modern technology from sonar, radio, and television to microwave heating and electromagnetic compatibility analysis. Mathematical modeling of these waves has undergone considerable growth in recent years, and this timely book, written by a leading international researcher, presents the research in a careful and complete way.

Direct and Inverse Problems

A Publication of the Shock and Vibration Information Center, Naval Research Laboratory

Large-Scale Structures in Acoustics and Electromagnetics

Mathematical Aspects and Applications

Modern Solvers for Helmholtz Problems

Direct Methods in the Calculus of Variations

The inverse scattering problem is central to many areas of science and technology such as radar and sonar, medical imaging, geophysical exploration and nondestructive testing. This book is devoted to the mathematical and numerical analysis of the inverse scattering problem for acoustic and electromagnetic waves. In this third edition, new sections have been added on the linear sampling and factorization methods for solving the inverse scattering problem as well as expanded treatments of iteration methods and uniqueness theorems for the inverse obstacle problem. These additions have in turn required an expanded presentation of both transmission eigenvalues and boundary integral equations in Sobolev spaces. As in the previous editions, emphasis has been given to simplicity over generality thus providing the reader with an accessible introduction to the field of inverse scattering theory. Review of earlier editions: "Colton and Kress have written a scholarly, state of the art account of their view of direct and inverse scattering. The book is a pleasure to read as a graduate text or to dip into at leisure. It suggests a number of open problems and will be a source of inspiration for many years to come." SIAM Review, September 1994 "This book should be on the desk of any researcher, any student, any teacher interested in scattering theory." Mathematical Intelligencer, June 1994

Contents:Light Scattering Problems in Astrophysics (J M Perrin)Surface Integral Operators and their Use in Acoustics and Electromagnetics (A Berthon)Acoustic Diffraction by Slender Bodies of Arbitrary Shape (M Tran-Van-Nhieu)High and Low Energy Approximations for the Electromagnetic Scattering by Irregular Objects (B Torresani)Electromagnetic Scattering and Mutual Interactions Between Closely Spaced Spheroids (J Dalmas & R Deleuil)Acoustical Imaging of 2D Fluid Targets Buried in a Half Space: A Diffraction Tomography Approach Using Line-Sources Insonification (B Duchene et al)Contribution of Radar Polarimetry in Radar Target Discrimination. The "Poincaré Planisphere": a New Representation Method (E Pottier)Electromagnetic and Acoustic Waves in Random Media: from Propagation to Anderson Localization (B Souillard)Weak Disorder: Homogeneisation Method and Propagation (C Bardos)Coherent Propagation of Surface Acoustic Waves in Quasi-Periodic and Random Arrays of Grooves (D Sornette et al)On Asymptotic Behaviour of Waves States in Random Media (F Bentosela & R Rodriguez)A Study of Acoustic Transmission of Transient Signal in a Inhomogeneous Medium with the Help of a Wavelet Transform. Application to an Air-Water Plane Interface (G Saracco & Ph Tchamitchian)Three-Dimensional Impedance Scattering Theory (P Sabatier)Survey of Optimization Algorithms Applied to Inverse Problems (A Roger)A Linearized Inverse Problem: Acoustic Impedance Tomography of Biological Media (J P Lefebvre)and others Readership: Electrical engineers and mathematicians.

The book of invited articles offers a collection of high-quality papers in selected and highly topical areas of Applied and Numerical Mathematics and Approximation Theory which have some connection to Wolfgang Dahmen's scientific work. On the occasion of his 60th birthday, leading experts have contributed survey and research papers in the areas of Nonlinear Approximation Theory, Numerical Analysis of Partial Differential and Integral Equations, Computer-Aided Geometric Design, and Learning Theory. The main focus and common theme of all the articles in this volume is the mathematics building the foundation for most efficient numerical algorithms for simulating complex phenomena.

This classic book provides a rigorous treatment of the Riesz?Fredholm theory of compact operators in dual systems, followed by a derivation of the jump relations and mapping properties of scalar and vector potentials in spaces of continuous and HÓlder continuous functions. These results are then used to study scattering problems for the Helmholtz and Maxwell equations. Readers will benefit from a full discussion of the mapping properties of scalar and vector potentials in spaces of continuous and HÓlder continuous functions, an in-depth treatment of the use of boundary integral equations to solve scattering problems for acoustic and electromagnetic waves, and an introduction to inverse scattering theory with an emphasis on the ill-posedness and nonlinearity of the inverse scattering problem.

Implementations, Algorithms and Applications

Convolution Quadrature Applied to Time Domain Acoustic and Electromagnetic Scattering Problems

Domain Decomposition Methods in Science and Engineering XXII

Boundary Element Analysis

Artificial Boundary Method

Acoustic and Electromagnetic Diffraction by Canonical Structures

This book presents important recent developments in mathematical and computational methods used in impedance imaging and the theory of composite materials. By augmenting the theory with interesting practical examples and numerical illustrations, the exposition brings simplicity to the advanced material. An introductory chapter covers the necessary basics. An extensive bibliography and open problems at the end of each chapter enhance the text.

Most physical systems lose or gain stability through bifurcation behavior. This book explains a series of experimentally found bifurcation phenomena by means of the methods of static bifurcation theory.

State-of-the-art in qualitative theory of functional differential equations; Most of the new material has never appeared in book form and some not even in papers; Second edition updated with new topics and results; Methods discussed will apply to other equations and applications

Although the analysis of scattering for closed bodies of simple geometric shape is well developed, structures with edges, cavities, or inclusions have seemed, until now, intractable to analytical methods. This two-volume set describes a breakthrough in analytical techniques for accurately determining diffraction from classes of canonical scatterers

Dynamics in Infinite Dimensions

Dedicated to Wolfgang Dahmen on the Occasion of his 60th Birthday

Multi-wave Medical Imaging: Mathematical Modelling And Imaging Reconstruction

Abstract and Applied Analysis

Selected papers from the ICOSAHOM conference, June 25-29, 2012, Gammarth, Tunisia

Many physical problems that are usually solved by differential equation techniques can be solved more effectively by integral equation methods. This work focuses exclusively on singular integral equations and on the distributional solutions of these equations. A large number of beautiful mathematical concepts are required to find such solutions, which in tum, can be applied to a wide variety of scientific fields - potential theory, me chanics, fluid dynamics, scattering of acoustic, electromagnetic and earth quake waves, statistics, and population dynamics, to cite just several. An integral equation is said to be singular if the kernel is singular within the range of integration, or if one or both limits of integration are infinite. The singular integral equations that we have studied extensively in this book are of the following type. In these equations f (x) is a given function and g(y) is the unknown function. 1. The Abel equation x x) = l g (y) d 0

This edited volume offers a state of the art overview of fast and robust solvers for the Helmholtz equation. The book consists of three parts: new developments and analysis in Helmholtz solvers, practical methods and implementations of Helmholtz solvers, and industrial applications. The Helmholtz equation appears in a wide range of science and engineering disciplines in which wave propagation is modeled. Examples are: seismic inversion, ultrasone medical imaging, sonar detection of submarines, waves in harbours and many more. The partial differential equation looks simple but is hard to solve. In order to approximate the solution of the problem numerical methods are needed. First a discretization is done. Various methods can be used: (high order) Finite Difference Method, Finite Element Method, Discontinuous Galerkin Method and Boundary Element Method. The resulting linear system is large, where the size of the problem increases with increasing frequency. Due to higher frequencies the seismic images need to be more detailed and, therefore, lead to numerical problems of a larger scale. To solve these three dimensional problems fast and robust, iterative solvers are required. However for standard iterative methods the number of iterations to solve the system becomes too large. For these reason a number of new methods are developed to overcome this hurdle. The book is meant for researchers both from academia and industry and graduate students. A prerequisite is knowledge on partial differential equations and numerical linear algebra.

This is nothing less than an essential text in what is a new and growing discipline. Electromagnetic modeling and computations is expanding as a result of the steadily increasing demand for designing electrical devices, modeling electromagnetic materials, and simulating electromagnetic fields in nanoscale structures. The aim of this volume is to bring together prominent worldwide experts to review state-of-the-art developments and future trends of modeling and computations in electromagnetics.

In the past three decades, bifurcation theory has matured into a well-established and vibrant branch of mathematics. This book gives a unified presentation in an abstract setting of the main theorems in bifurcation theory, as well as more recent and lesser known results. It covers both the local and global theory of one-parameter bifurcations for operators acting in infinite-dimensional Banach spaces, and shows how to apply the theory to problems involving partial differential equations. In addition to existence, qualitative properties such as stability and nodal structure of bifurcating solutions are treated in depth. This volume will serve as an important reference for mathematicians, physicists, and theoretically-inclined engineers working in bifurcation theory and its applications to partial differential equations.

The Shock and Vibration Digest

Singular Integral Equations

Acoustic and Electromagnetic Equations

Optimization and Control for Partial Differential Equations

Proceedings of the 11th ISAAC Congress, Växjö (Sweden) 2017

Proceedings of the GAMM Workshop on Computational Electromagnetics, Kiel, Germany, January 26–28, 2001

This is the second edition of the book which has two additional new chapters on Maxwell's equations as well as a section on properties of solution spaces of Maxwell's equations and their trace spaces. These two new chapters, which summarize the most up-to-date results in the literature for the Maxwell's equations, are sufficient enough to serve as a self-contained introductory book on the modern mathematical theory of boundary integral equations in electromagnetics. The book now contains 12 chapters and is divided into two parts. The first six chapters present modern mathematical theory of boundary integral equations that arise in fundamental problems in continuum mechanics and electromagnetics based on the approach of variational formulations of the equations. The second six chapters present an introduction to basic classical theory of the pseudo-differential operators. The aforementioned corresponding boundary integral operators can now be recast as pseudo-differential operators. These serve as concrete examples that illustrate the basic ideas of how one may apply the theory of pseudo-differential operators and their calculus to obtain additional properties for the corresponding boundary integral operators. These two different approaches are complementary to each other. Both serve as the mathematical foundation of the boundary element methods, which have become extremely popular and efficient computational tools for boundary problems in applications. This book contains a wide spectrum of boundary integral equations arising in fundamental problems in continuum mechanics and electromagnetics. The book is a major scholarly contribution to the modern approaches of boundary integral equations, and should be accessible and useful to a large community of advanced graduate students and researchers in mathematics, physics, and engineering.

Providing readers with a solid basis in dynamical systems theory, as well as explicit procedures for application of general mathematical results to particular problems, the focus here is on efficient numerical implementations of the developed techniques. The book is designed for advanced undergraduates or graduates in applied mathematics, as well as for Ph.D. students and researchers in physics, biology, engineering, and economics who use dynamical systems as model tools in their studies. A moderate mathematical background is assumed, and, whenever possible, only elementary mathematical tools are used. This new edition preserves the structure of the first while updating the context to incorporate recent theoretical developments, in particular new and improved numerical methods for bifurcation analysis.

These are the proceedings of the 22nd International Conference on Domain Decomposition Methods, which was held in Lugano, Switzerland. With 172 participants from over 24 countries, this conference continued a long-standing tradition of internationally oriented meetings on Domain Decomposition Methods. The book features a well-balanced mix of established and new topics, such as the manifold theory of Schwarz Methods, Isogeometric Analysis, Discontinuous Galerkin Methods, exploitation of modern HPC architectures and industrial applications. As the conference program reflects, the growing capabilities in terms of theory and available hardware allow increasingly complex non-linear and multi-physics simulations, confirming the tremendous potential and flexibility of the domain decomposition concept.

We analyze the use of the convolution quadrature (CQ) method for the temporal discretization of some time domain boundary integral equations arising in acoustic and electromagnetic scattering problems. By choosing a suitable A-stable multistep method, the CQ method can provide a stable numerical time evolution method. The analysis of this approach is based on deriving new parameter dependent bounds on integral operators in the Laplace transform domain. In particular, we study the electric field integral equation in electromagnetism and several combined field integral equations in acoustics and electromagnetism. A full error analysis is derived in two cases, and numerical results are also presented.

Multiscale, Nonlinear and Adaptive Approximation

Boundary Integral Equations

Analysis, Probability, Applications, and Computation

Electrostatics in Solvation, Scattering, and Electron Transport

Canonical Problems in Scattering and Potential Theory Part II

Computational Methods for Electromagnetic Phenomena

This volume contains eleven contributions on boundary integral equation and boundary element methods. Beside some historical and more analytical aspects in the formulation and analysis of boundary integral equations, modern fast boundary element methods are also described and analyzed from a mathematical point of view. In addition, the book presents engineering and industrial applications that show the ability of boundary element methods to solve challenging problems from different fields.

This book presents advances in high performance computing as well as advances accomplished using high performance computing. It contains a collection of papers presenting results achieved in the collaboration of scientists from computer science, mathematics, physics, and mechanical engineering. From science problems to mathematical algorithms and on to the effective implementation of these algorithms on massively parallel and cluster computers, the book presents state-of-the-art methods and technology, and exemplary results in these fields.

"Artificial Boundary Method" systematically introduces the artificial boundary method for the numerical solutions of partial differential equations in unbounded domains. Detailed discussions treat different types of problems, including Laplace, Helmholtz, heat, Schrödinger, and Navier and Stokes equations. Both numerical methods and error analysis are discussed. The book is intended for researchers working in the fields of computational mathematics and mechanical engineering. Prof. Houde Han works at Tsinghua University, China; Prof. Xiaonan Wu works at Hong Kong Baptist University, China.

The dimmed outlines of phenomenal things all into one another unless we put on the merge focusing-glass of theory, and screw it up some times to one pitch of definition and sometimes to another, so as to see down into different depths through the great millstone of the world James Clerk Maxwell (1831 - 1879) For a long time after the foundation of the modern theory of electromag netism by James Clerk Maxwell in the 19th century, the mathematical ap proach to electromagnetic field problems was for a long time dominated by the analytical investigation of Maxwell's equations. The rapid development of computing facilities during the last century has then necessitated appropriate numerical methods and algorithmic tools for the simulation of electromagnetic phenomena. During the last few decades, a new research area "Computational Electromagnetics" has emerged com prising the mathematical analysis, design, implementation, and application of numerical schemes to simulate all kinds of relevant electromagnetic pro cesses. This area is still rapidly evolving with a wide spectrum of challenging issues featuring, among others, such problems as the proper choice of spatial discretizations (finite differences, finite elements, finite volumes, boundary elements), fast solvers for the discretized equations (multilevel techniques, domain decomposition methods, multipole, panel clustering), and multiscale aspects in microelectronics and micromagnetics.

Topics in Computational Wave Propagation

Uncertainty quantification, open and closed-loop control, and shape optimization

Integral Representations for Harmonic Problems

Polarization and Moment Tensors

Parallel Algorithms and Cluster Computing

Elements of Applied Bifurcation Theory

This book is developed for the study of vectorial problems in the calculus of variations. The subject is a very active one and almost half of the book consists of new material. This is a new edition of the earlier book published in 1989 and it is suitable for graduate students. The book has been updated with some new material and examples added. Applications are included.

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.

Acoustic and electromagnetic waves underlie a range of modern technology from sonar, radio, and television to microwave heating and electromagnetic compatibility analysis. This book, written by an international researcher, presents some of the research in a complete way. It is useful for graduate students in mathematics, physics, and engineering.

This volume takes up various topics in Mathematical Analysis including boundary and initial value problems for Partial Differential Equations and Functional Analytic methods.Topics include linear elliptic systems for composite material ? the coefficients may jump from domain to domain; Stochastic Analysis ? many applied problems involve evolution equations with random terms, leading to the use of stochastic analysis.The proceedings have been selected for coverage in: ? Index to Scientific & Technical Proceedings (ISTP CDROM version / ISI Proceedings)? CC Proceedings ? Engineering & Physical Sciences

Computational Electromagnetics

Engineering Use of Group-Theoretic Bifurcation Theory

Proceedings of the International Conference, Hanoi, Vietnam, 13-17 August 2002

Modeling and Computations in Electromagnetics

Imperfect Bifurcation in Structures and Materials

Aeroacustic and Vibroacoustic Advancement in Aerospace and Automotive Systems

This book is a printed edition of the Special Issue "Advances in Vibroacoustics and Aeroacustics of Aerospace and Automotive Systems" that was published in Applied Sciences

Bifurcation Theory