Volterra Integral Equations And Fractional Calculus Do

In recent decades, significant interest, based on physics and engineering applications, has developed on so-called anomalous diffusion processes that possess different spread functions with classical ones. The resulting differential equation whose fundamental solution matches this decay process is best modeled by an equation containing a fractional order derivative. This dissertation mainly focuses on some inverse problems for fractional diffusion equations. After some background introductions and preliminaries in Section 1 and 2, in the third section we consider our first inverse boundary problem. This is where an unknown boundary condition is to be determined from overposed data in a time- fractional diffusion equation. Based upon the fundamental solution in free space, we derive a representation for the unknown parameters as the solution of a nonlinear Volterra integral equation of second kind with a weakly singular kernel. We are able to make physically reasonable assumptions on our constraining functions (initial and given boundary values) to be able to prove a uniqueness and reconstruction result. This is achieved by an iterative process and is an immediate result of applying a certain fixed point theorem. Numerical examples are presented to illustrate the validity and effectiveness of the proposed method. In the fourth section a reaction-diffusion problem with an unknown nonlinear source function, which has to be determined from overposed data, is considered. A uniqueness result is proved and a numerical algorithm including convergence analysis under some physically reasonable assumptions is presented in the one-dimensional case. To show effectiveness of the proposed method, some results of numerical simulations are presented. In Section 5, we also attempted to reconstruct a nonlinear source in a heat equation from a number of known input sources. This represents a new research even for the case of classical diffusion and would be the first step in a solution method for the fractional diffusion case. While analytic work is still in progress on this problem, Newton and Quasi-Newton method are applied to show the feasibility of numerical reconstructions. In conclusion, the fractional diffusion equations have some different properties with the classical ones but there are some similarities between them. The classical tools like integral equations and fixed point theory still hold under slightly different assumptions. Inverse problems for fractional diffusion equations have applications in many engineering and physics areas such as material design, porous media. They are trickier than classical ones but there are also some advantages due to the mildly ill-conditioned singularity caused by the new kernel functions. The electronic version of this dissertation is accessible from http://hdl.handle.net/1969.1/151079

The book presents efficient numerical methods for simulation and analysis of physical processes exhibiting fractional order (FO) dynamics. The book introduces FO system identification method to

estimate parameters of a mathematical model under consideration from experimental or simulated data. A simple tuning technique, which aims to produce a robust FO PID controller exhibiting iso-damping property during re-parameterization of a plant, is devised in the book. A new numerical method to find an equivalent finite dimensional integer order system for an infinite dimensional FO system is developed in the book. The book also introduces a numerical method to solve FO optimal control problems. Key features Proposes generalized triangular function operational matrices. Shows significant applications of triangular orthogonal functions as well as triangular strip operational matrices in simulation, identification and control of fractional order processes. Provides numerical methods for simulation of physical problems involving different types of weakly singular integral equations, Abel's integral equation, fractional order integro-differential equations, fractional order differential and differential-algebraic equations, and fractional order partial differential equations. Suggests alternative way to do numerical computation of fractional order signals and systems and control. Provides source codes developed in MATLAB for each chapter, allowing the interested reader to take advantage of these codes for broadening and enhancing the scope of the book itself and developing new results.

This book presents numerical methods and computational aspects for linear integral equations. Such equations occur in various areas of applied mathematics, physics, and engineering. The material covered in this book, though not exhaustive, offers useful techniques for solving a variety of problems. Historical information cover ing the nineteenth and twentieth centuries is available in fragments in Kantorovich and Krylov (1958), Anselone (1964), Mikhlin (1967), Lonseth (1977), Atkinson (1976), Baker (1978), Kondo (1991), and Brunner (1997). Integral equations are encountered in a variety of applications in many fields including continuum mechanics, potential theory, geophysics, electricity and mag netism, kinetic theory of gases, hereditary phenomena in physics and biology, renewal theory, quantum mechanics, radiation, optimization, optimal control sys tems, communication theory, mathematical economics, population genetics, queue ing theory, and medicine. Most of the boundary value problems involving differ ential equations can be converted into problems in integral equations, but there are certain problems which can be formulated only in terms of integral equations. A computational approach to the solution of integral equations is, therefore, an essential branch of scientific inquiry.

The theory of integral equations has a close contact with many different areas of mathematics. This is sufficient to say that there is almost no area of applied sciences and physics where integral equations do not play an important role. This books intended primarily to study the existence of solution, analytically and numerically, of nonlinear integral equations of the second kind of types Hammerstein, Hammerstein- Volterra and Volterra-Hammerstein. Also, it is used for proving the existence and uniqueness solution, analytically, of linear integro-differential and integral equations of type

Fredholm-Volterra in three dimensional. Finally, it is very useful in establishing the existence and uniqueness solution of linear and nonlinear partial differential equations of fractional order, analytically and numerically.

Advances in Nonlinear Analysis via the Concept of Measure of Noncompactness

Fractals and Fractional Calculus in Continuum Mechanics

Fractional Linear Multistep Methods for Abel-Volterra Integral Equations of the Second Kind

Integral Equations and Integro-Partial Differential Equations

Analysis and Applications

Computational Methods for Linear Integral Equations

This book looks at the theories of Volterra integral and functional equations.

The book is characterized by the illustration of cases of fractal, self-similar and multi-scale structures taken from the mechanics of solid and porous materials, which have a technical interest. In addition, an accessible and self-consistent treatment of the mathematical technique of fractional calculus is provided, avoiding useless complications.

This book deals with the numerical solution of integral equations based on approximation of functions and the authors apply wavelet approximation to the unknown function of integral equations. The book's goal is to categorize the selected methods and assess their accuracy and efficiency.

This is the first book to present a systematic review of applications of the Haar wavelet method for solving Calculus and Structural Mechanics problems. Haar wavelet-based solutions for a wide range of problems, such as various differential and integral equations, fractional equations, optimal control theory, buckling, bending and vibrations of elastic beams are considered. Numerical examples demonstrating the efficiency and accuracy of the Haar method are provided for all solutions.

Analytical and Numerical Methods for Volterra Equations

Theory and Applications of Convolution Integral Equations

Theory, Methods and Applications

Fuzzy Fractional Differential Equations

An Operational Haar Wavelet Method for Solving Fractional Volterra Integral Equations

Methods and Applications

Presents an aspect of activity in integral equations methods for the solution of Volterra equations for those who need to solve real-world problems. Since there are few known analytical methods leading to closed-form solutions, the emphasis is on numerical techniques. The major points of the analytical methods used to study the properties of the solution are presented in the first part of the book. These techniques are important for gaining insight into the qualitative behavior of the solutions and for designing effective numerical methods. The second part of the book is devoted entirely to numerical methods. The author has chosen the simplest possible setting for the discussion, the space of real functions of real variables. The text is supplemented by examples and exercises. /homepage/sac/cam/na2000/index.html7-Volume Set now available at special set price ! This volume contains contributions in the area of differential equations and integral equations. Many numerical methods have arisen in response to the need to solve "real-life" problems in applied mathematics, in particular problems that do not have a closed-form solution. Contributions on both initial-value problems and boundary-value problems in ordinary differential equations appear in this volume. Numerical methods for initial-value problems in ordinary differential equations fall naturally into two classes: those which use one starting value at each step (one-step methods) and those which are based on several values of the solution (multistep methods). John Butcher has supplied an expert's perspective of the development of numerical methods for ordinary differential equations in the 20th century. Rob Corless and Lawrence Shampine talk about established technology, namely software for initial-value problems using Runge-Kutta and Rosenbrock methods, with interpolants to fill in the solution between mesh-points, but the 'slant' is new - based on the question, "How should such software integrate into the current generation of Problem Solving Environments?" Natalia Borovykh and Marc Spijker study the problem of establishing upper bounds for the norm of the nth power of square matrices. The dynamical system viewpoint has been of great benefit to ODE theory and numerical methods. Related is the study of chaotic behaviour. Willy Govaerts discusses the numerical methods for the computation and continuation of equilibria and bifurcation points of equilibria of dynamical systems. Arieh Iserles and Antonella Zanna survey the construction of Runge-Kutta methods which preserve algebraic invariant functions. Valeria Antohe and Ian Gladwell present numerical experiments on solving a Hamiltonian system of Hénon and Heiles with a symplectic and a nonsymplectic method with a variety of precisions and initial conditions. Stiff differential equations first became recognized as special during the 1950s. In 1963 two seminal publications laid to the foundations for later development: Dahlquist's paper on A-stable multistep methods and Butcher's first paper on implicit Runge-Kutta methods. Ernst Hairer and Gerhard Wanner deliver a survey which retraces the discovery of the order stars as well as the principal achievements obtained by that theory. Guido Vanden Berghe, Hans De Meyer, Marnix Van Daele and Tanja Van Hecke construct exponentially fitted Runge-Kutta methods with s stages. Differential-algebraic equations arise in control, in modelling of mechanical systems and in many other fields. Jeff Cash describes a fairly recent class of formulae for the numerical solution of initial-value problems for stiff and differential-algebraic systems. Shengtai Li and Linda Petzold describe methods and software for sensitivity analysis of solutions of DAE initial-value problems. Again in the area of differential-algebraic systems, Neil Biehn, John Betts, Stephen Campbell and William Huffman present current work on mesh adaptation for DAE two-point boundary-value problems. Contrasting approaches to the question of how good an approximation is as a solution of a given equation involve (i) attempting to estimate the actual error (i.e., the difference between the true and the approximate solutions) and (ii) attempting to estimate the defect - the amount by which the approximation fails to satisfy the given equation and any side-conditions. The paper by Wayne Enright on defect control relates to carefully analyzed techniques that have been proposed both for ordinary differential equations and for delay differential equations in which an attempt is made to control an estimate of the size of the defect. Many phenomena incorporate noise, and the numerical solution of stochastic differential equations has developed as a relatively new item of study in the area. Keven Burrage, Pamela Burrage and Taketomo Mitsui review the way numerical methods for solving stochastic differential equations (SDE's) are constructed. One of the more recent areas to attract scrutiny has been the area of differential equations with after-effect (retarded, delay, or neutral delay differential equations) and in this volume we include a number of papers on evolutionary problems in this area. The paper of Genna Bocharov and Fathalla Rihan conveys the importance in mathematical biology of models using retarded differential equations. The contribution by Christopher Baker is intended to convey much of the background necessary for the application of numerical methods and includes some original results on stability and on the solution of approximating equations. Alfredo Bellen, Nicola Guglielmi and Marino Zennaro contribute to the analysis of stability of numerical solutions of nonlinear neutral differential equations. Koen Engelborghs, Tatyana Luzyanina, Dirk Roose, Neville Ford and Volker Wulf consider the numerics of bifurcation in delay differential equations. Evelyn Buckwar contributes a paper indicating the construction and analysis of a numerical strategy for stochastic delay differential equations (SDDEs). This volume contains contributions on both Volterra and Fredholm-type integral equations. Christopher Baker responded to a late challenge to craft a review of the theory of the basic numerics of Volterra integral and integro-differential equations. Simon Shaw and John Whiteman discuss Galerkin methods for a type of Volterra integral equation that arises in modelling viscoelasticity. A subclass of boundary-value problems for ordinary differential equation comprises eigenvalue problems such as Sturm-Liouville problems (SLP) and Schrödinger equations. Liviu Ixaru describes the advances made over the last three decades in the field of piecewise perturbation methods for the numerical solution of Sturm-Liouville problems in general and systems of Schrödinger equations in particular. Alan Andrew surveys the asymptotic correction method for regular Sturm-Liouville problems. Leon Greenberg and Marco Marletta survey methods for higher-order Sturm-Liouville problems. R. Moore in the 1960s first showed the feasibility of validated solutions of differential equations, that is, of computing guaranteed enclosures of solutions. Boundary integral equations. Numerical solution of integral equations associated with boundary-value problems has experienced continuing interest. Peter Junghanns and Bernd Silbermann present a selection of modern results concerning the numerical analysis of one-dimensional Cauchy singular integral equations, in particular the stability of operator sequences associated with different projection methods. Johannes Elschner and Ivan Graham summarize the most important results achieved in the last years about the numerical solution of one-dimensional integral equations of Mellin type of means of projection methods and, in particular, by collocation methods. A survey of results on quadrature methods for solving boundary integral equations is presented by Andreas Rathsfeld. Wolfgang Hackbusch and Boris Khoromski present a novel approach for a very efficient treatment of integral operators. Ernst Stephan examines multilevel methods for the h-, p- and hp- versions of the boundary element method, including pre-conditioning techniques. George Hsiao, Olaf Steinbach and Wolfgang Wendland analyze various boundary element methods employed in local discretization schemes.

In this work, the Haar wavelet operational matrix of fractional integration is first obtained. Haar wavelet approximating method is then utilized to reduce the fractional Volterra integral equations (which are also called the weakly-singular linear Volterra integral equations) and in particular the Abel integral equations, to a system of algebraic equations. An error bound is estimated and some numerical examples are included to demonstrate the validity and applicability of the method.

A guide to the new research in the field of fractional order analysis Fractional Order Analysis contains the most recent research findings in fractional order analysis and its applications. The authors—noted experts on the topic—offer an examination of the theory, methods, applications, and the modern tools and techniques in the field of fractional order analysis. The information, tools, and applications presented can help develop mathematical methods and models with better accuracy. Comprehensive in scope, the book covers a range of topics including: new fractional operators, fractional derivatives, fractional differential equations, inequalities for different fractional derivatives and fractional integrals, fractional modeling related to transmission of Malaria, and dynamics of Zika virus with various fractional derivatives, and more. Designed to be an accessible text, several useful, relevant and connected topics can be found in one place, which is crucial for an understanding of the research problems of an applied nature. This book: Contains recent development in fractional calculus Offers a balance of theory, methods, and applications Puts the focus on fractional analysis and its interdisciplinary applications, such as fractional models for biological models Helps make research more relevant to real-life applications Written for researchers, professionals and practitioners, Fractional Order Analysis offers a comprehensive resource to fractional analysis and its many applications as well as information on the newest research.

Engineering Applications

With Applications

Mathematical Analysis and Applications

Advances in Harmonic Analysis and Operator Theory

Novel Methods for Solving Linear and Nonlinear Integral Equations
The Optimal Homotopy Asymptotic Method

Collocation based on piecewise polynomial approximation represents a powerful class of methods for the numerical solution of initial-value problems for functional differential and integral equations arising in a wide spectrum of applications, including biological and physical phenomena. The present book introduces the reader to the general principles underlying these methods and then describes in detail their convergence properties when applied to ordinary differential equations, functional equations with (Volterra type) memory terms, delay equations, and differential-algebraic and integral-algebraic equations. Each chapter starts with a self-contained introduction to the relevant theory of the class of equations under consideration. Numerous exercises and examples are supplied, along with extensive historical and bibliographical notes utilising the vast annotated reference list of over 1300 items. In sum, Hermann Brunner has written a treatise that can serve as an introduction for students, a guide for users, and a comprehensive resource for experts.

This nine-chapter monograph introduces a rigorous investigation of q-difference operators in standard and fractional settings. It starts with elementary calculus of q-differences and integration of Jackson's type before turning to q-difference equations. The existence and uniqueness theorems are derived using successive approximations, leading to systems of equations with retarded arguments. Regular q-Sturm–Liouville theory is also introduced; Green's function is constructed and the eigenfunction expansion theorem is given. The monograph also discusses some integral equations of Volterra and Abel type, as introductory material for the study of fractional q-calculi. Hence fractional q-calculi of the types Riemann–Liouville; Grünwald–Letnikov; Caputo; Erdélyi–Kober and Weyl are defined analytically. Fractional q-Leibniz rules with applications in q-series are also obtained with rigorous proofs of the formal results of Al-Salam-Verma, which remained unproved for decades. In working towards the investigation of q-fractional difference equations; families of q-Mittag-Leffler functions are defined and their properties are investigated, especially the q-Mellin–Barnes integral and Hankel contour integral representation of the q-Mittag-Leffler functions under consideration, the distribution, asymptotic and reality of their zeros, establishing q-counterparts of Wiman's results. Fractional q-difference equations are studied; existence and uniqueness theorems are given and classes of Cauchy-type problems are completely solved in terms of families of q-Mittag-Leffler functions. Among many q-analogs of classical results and concepts, q-Laplace, q-Mellin and q2-Fourier transforms are studied and their applications are investigated.

This second edition integrates the newly developed methods with classical techniques to give both modern and powerful approaches for solving integral equations. It provides a comprehensive treatment of linear and nonlinear Fredholm and Volterra integral equations of the first and second kinds. The materials are presented in an accessible and straightforward manner to readers, particularly those from non-mathematics backgrounds. Numerous well-explained applications and examples as well as practical exercises are presented to guide readers through the text. Selected applications from mathematics, science and engineering are investigated by using the newly developed methods. This volume consists of nine chapters, pedagogically *organized, with six chapters devoted to linear integral equations, two chapters on nonlinear integral equations, and the last chapter on applications. It is intended for scholars and researchers, and can be used for advanced undergraduate and graduate students in applied mathematics, science and engineering. Click here for solutions manual.*

Unparalleled in scope compared to the literature currently available, the Handbook of Integral Equations, Second Edition contains over 2,500 integral equations with solutions as well as analytical and numerical methods for solving linear and nonlinear equations. It explores Volterra, Fredholm, Wiener–Hopf, Hammerstein, Uryson, and other equations that arise in mathematics, physics, engineering, the sciences, and economics. With 300 additional pages, this edition covers much more material than its predecessor. New to the Second Edition • New material on Volterra, Fredholm, singular, hypersingular, dual, and nonlinear integral equations, integral transforms, and special functions • More than 400 new equations with exact solutions • New chapters on mixed multidimensional equations and methods of integral equations for ODEs and PDEs • Additional examples for illustrative purposes To accommodate different mathematical backgrounds, the authors avoid wherever possible the use of special terminology, outline some of the methods in a schematic, simplified manner, and arrange the material in increasing order of complexity. The book can be used as a database of test problems for numerical and approximate methods for solving linear and nonlinear integral equations.

Haar Wavelets

Implicit Fractional Differential and Integral Equations

Fractional Order Analysis

Collocation Methods for Volterra Integral and Related Functional Differential Equations

Theory and Applications

On System of Volterra Integro-Fractional Differential Equations

In summary, the author has provided an elegant introduction to important topics in the theory of ordinary differential equations and integral equations. -- Mathematical Reviews This book is intended for a one-semester course in differential and integral equations for advanced undergraduates or beginning graduate students, with a view toward preparing the reader for graduate-level courses on more advanced topics. There is some emphasis on existence, uniqueness, and the qualitative behavior of solutions. Students from applied mathematics, physics, and engineering will find much of value in this book. The first five chapters cover ordinary differential equations. Chapter 5 contains a good treatment of the stability of ODEs. The next four chapters cover integral equations, including applications to second-order differential equations. Chapter 7 is a concise introduction to the important Fredholm theory of linear integral equations. The final chapter is a well-selected collection of fascinating miscellaneous facts about differential and integral equations. The prerequisites are a good course in advanced calculus, some preparation in linear algebra, and a reasonable acquaintance with elementary complex analysis. There are exercises throughout the text, with the more advanced of them providing good challenges to the student.

This work aims to present, in a systematic manner, results including the existence and uniqueness of solutions for the Cauchy Type and Cauchy problems involving nonlinear ordinary fractional differential equations.

This book deals with the study of sequence spaces, matrix transformations, measures of noncompactness and their various applications. The notion of measure of noncompactness is one of the most useful ones available and has many applications. The book discusses some of the existence results for various types of differential and integral equations with the help of measures of noncompactness; in particular, the Hausdorff measure of noncompactness has been applied to obtain necessary and sufficient conditions for matrix operators between BK spaces to be compact operators. The book consists of eight self-contained chapters. Chapter 1 discusses the theory of FK spaces and Chapter 2 various duals of sequence spaces, which are used to characterize the matrix classes between these sequence spaces (FK and BK spaces) in Chapters 3 and 4. Chapter 5 studies the notion of a measure of noncompactness and its properties. The techniques associated with measures of noncompactness are applied to characterize the compact matrix operators in Chapters 6. In Chapters 7 and 8, some of the existence results are discussed for various types of differential and integral equations, which are obtained with the help of argumentations based on compactness conditions.

This thesis presents three new numerical schemes for a class of fractional differential equations. The presented schemes are a Quadratic, a Cubic, and a Slope method. In these approaches, the differential equations are expressed in terms of Caputo type fractional derivatives. Properties of the Caputo derivative allow one to reduce the fractional differential equation into a Volterra type integral equation. Once this is done, a number of numerical schemes for the Volterra type integral equations can be applied to find the numerical solution of fractional differential equations. In all schemes, the entire domain is divided into several equal small domains. In the quadratic and the cubic methods, the distribution of the unknown function over the domain is expressed in terms of the function values at the node points. The slopes between the node points are not constant for the quadratic and the cubic methods. In the slope method, the distribution of the unknown function over the domain is expressed in terms of the function values and its slopes at the node points. The slope method explicitly imposes continuity of the slopes at the node points. These approximations are then substituted into the Volterra type integral equation to reduce it to a set of algebraic equations. These methods are used to solve linear and nonlinear problems. The Slope method uses two different types of polynomials, cubic order and fractional order, to develop two algorithms. Results obtained using quadratic, cubic, and slope methods agree with the analytical results and the numerical results obtained using other schemes. It is shown that the numerical solutions of fractional differential equations using fractional order polynomials for slope method may be more suitable than the integer order polynomials for slope method. In addition, the thesis presents a comparative study of the performance of five different numerical schemes for the solution of fractional differential equations to examine the stability, accuracy, and computational speed of the algorithms. The schemes considered for comparative study, are a Linear, a Quadratic, a Cubic, a State-space non-integer integrator, and a Direct discretization method.

A First Course in Integral Equations

Theory and Applications of Fractional Differential Equations

New Numerical Schemes for the Solution of Fractional Differential Equations

Fuzzy Fractional Differential Operators and Equations

q-Fractional Calculus and Equations

Fractional Order Processes

This volume is dedicated to Professor Stefan Samko on the occasion of his seventieth birthday. The contributions display the range of his scientific interests in harmonic analysis and operator theory. Particular attention is paid to fractional integrals and derivatives, singular, hypersingular and potential operators in variable exponent spaces, pseudodifferential operators in various modern function and distribution spaces, as well as related applications, to mention but a few. Most contributions were firstly presented in two conferences at Lisbon and Aveiro, Portugal, in June – July 2011.

Linear and Nonlinear Integral Equations: Methods and Applications is a self-contained book divided into two parts. Part I offers a comprehensive and systematic treatment of linear integral equations of the first and second kinds. The text brings together newly developed methods to reinforce and complement the existing procedures for solving linear integral equations. The Volterra integral and integro-differential equations, the Fredholm integral and integro-differential equations, the Volterra-Fredholm integral equations, singular and weakly singular integral equations, and systems of these equations, are handled in this part by using many different computational schemes. Selected worked-through examples and exercises will guide readers through the text. Part II provides an extensive exposition on the nonlinear integral equations and their varied applications, presenting in an accessible manner a systematic treatment of ill-posed Fredholm problems, bifurcation points, and singular points. Selected applications are also investigated by using the powerful Pad é approximants. This book is intended for scholars and researchers in the fields of physics, applied mathematics and engineering. It can also be used as a text for advanced undergraduate and graduate students in applied mathematics, science and engineering, and related fields. Dr. Abdul-Majid Wazwaz is a Professor of Mathematics at Saint Xavier University in Chicago, Illinois, USA.

In chapter one, some new formulas for Caputo fractional derivatives of some elementary functions is given. The system of M-linear Voltera integro-fractional differential equations is reduced into a system of Voltera integral equations and the global and semiglobal fundamental existence and uniquenas theorems and presented in Chapter two. In chapter three, some analytic and approximate methods are applied to treat such a system. In chapter four, Runge-Kutta methods with different orders are given to treat such a system. The convergence and stability are also investigated. In chapter five, special Chebyshev method is considered. In chapter six, conclusions and recommendations with comparisons between the methods are included.

This book deals with the existence and stability of solutions to initial and boundary value problems for functional differential and integral equations and inclusions involving the Riemann-Liouville, Caputo, and Hadamard fractional derivatives and integrals. A wide variety of topics is covered in a mathematically rigorous manner making this work a valuable source of information for graduate students and researchers working with problems in fractional calculus. ContentsPreliminary Background Nonlinear Implicit Fractional Differential Equations Impulsive Nonlinear Implicit Fractional Differential Equations Boundary Value Problems for Nonlinear Implicit Fractional Differential Equations Boundary Value Problems for Impulsive NIFDE Integrable Solutions for Implicit Fractional Differential Equations Partial Hadamard Fractional Integral Equations and Inclusions Stability Results for Partial Hadamard Fractional Integral Equations and Inclusions Hadamard–Stieltjes Fractional Integral Equations Ulam Stabilities for Random Hadamard Fractional Integral Equations

20th International Conference, Cagliari, Italy, July 1–4, 2020, Proceedings, Part I

Ordinary Differential Equations and Integral Equations

Volterra Integral Equations

Handbook of Integral Equations

Numerical Methods for Fractional Calculus

Computational Science and Its Applications – ICCSA 2020

In this volume, we report new results about various theories and methods of integral equation, boundary value problems for partial differential equations and functional equations, and integral operators including singular integral equations, applications of boundary value problems and integral equations to mechanics and physics, numerical methods of integral equations and boundary value problems, theories and methods for inverse problems of mathematical physics, Clifford analysis and related problems. Contents:Some Properties of a Kind of Singular Integral Operator for K-Monogenic Function in Clifford Analysis (L P Wang, Z L Xu and Y Y Qiao)Some Results Related with Möbius Transformation in Clifford Analysis (Z X Zhang)The Scattering of SH Wave on the Array of Periodic Cracks in a Piezoelectric Substrate Bonded a Half-Plane of Functionally Graded Materials (J Q Liu, X Li, S Z Dong, X Y Yao and C F Wang)Anti-Plane Problem of Two Collinear Cracks in a Functionally Graded Coating–Substrate Structure (S H Ding and X Li)A Kind of Riemann Boundary Value Problem for Triharmonic Functions in Clifford Analysis (L F Gu)A New Dynamical Systems Method for Nonlinear Operator Equations (X J Luo, F C Li and S H Yang)A Class of Integral Inequality and Application (W S Wang)An Efficient Spectral Boundary Integral Equation Method for the Simulation of Earthquake Rupture Problems (W S Wang and B W Zhang)High-Frequency Asymptotics for the Modified Helmholtz Equation in a Half-Plane (H M Huang)An Inverse Boundary Value

Problem Involving Filtration for Elliptic Systems of Equations (Z L Xu and L Yan)Fixed Point Theorems of Contractive Mappings in Extended Cone Metric Spaces (H P Huang and X Li)Positive Solutions of Singular Third-Order Three-Point Boundary Value Problems (B Q Yan and X Liu)Modified Neumann Integral and Asymptotic Behavior in the Half-Space (Y H Zhang, G T Deng and Z Z Wei)Piecewise Tikhonov Regularization Scheme to Reconstruct Discontinuous Density in Computerized Tomography (J Cheng, Y Jiang, K Lin and J W Yan)About the Quaternionic Jacobian Conjecture (H Liu)Interaction Between Antiplane Circular Inclusion and Circular Hole of Piezoelectric Materials (L H Chang and X Li)Convergence of Numerical Algorithm for Coupled Heat and Mass Transfer in Textile Materials (M B Ge, J X Cheng and D H Xu)Haversian Cortical Bone with a Radial Microcrack (X Wang)Spectra of Unitary Integral Operators on L2(ℝ) with Kernels k(xy) (D W Ma and G Chen)The Numerical Simulation of Long-Period Ground Motion on Basin Effects (Y Q Li and X Li)Complete Plane Strain Problem of a One-Dimensional Hexagonal Quasicrystals with a Doubly-Periodic Set of Cracks (X Li and P P Shi)The Problem About an Elliptic Hole with III Asymmetry Cracks in One-Dimensional Hexagonal Piezoelectric Quasicrystals (H S Huo and X Li)The Second Fundamental Problem of Periodic Plane Elasticity of a One-Dimensional Hexagonal Quasicrystals (J Y Cui, P P Shi and X Li)The Optimal Convex Combination Bounds for the Centroidal Mean (H Liu and X J Meng)The Method of Fundamental Solution for a Class of Elliptical Partial Differential Equations with Coordinate Transformation and Image Technique (L N Wu and Q Jiang)Various Wavelet Methods for Solving Fractional Fredholm–Volterra Integral Equations (P P Shi, X Li and X Li) Readership: Researchers in analysis and differential equations. Keywords:Integral Equations;Boundary Value ProblemsKey Features:Provides new research progress on these topics

In many fields of application of mathematics, progress is crucially dependent on the good flow of information between (i) theoretical mathematicians looking for applications, (ii) mathematicians working in applications in need of theory, and (iii) scientists and engineers applying mathematical models and methods. The intention of this book is to stimulate this flow of information. In the first three chapters (accessible to third year students of mathematics and physics and to mathematically interested engineers) applications of Abel integral equations are surveyed broadly including determination of potentials, stereology, seismic travel times, spectroscopy, optical fibres. In subsequent chapters (requiring some background in functional analysis) mapping properties of Abel integral operators and their relation to other integral transforms in various function spaces are investi- gated, questions of existence and uniqueness of solutions of linear and nonlinear Abel integral equations are treated, and for equations of the first kind problems of ill-posedness are discussed. Finally, some numerical methods are described. In the theoretical parts, emphasis is put on the aspects relevant to applications.

This book includes different topics associated with integral and integro-differential equations and their relevance and significance in various scientific areas of study and research. Integral and integro-differential equations are capable of modelling many situations from science and engineering. Readers should find several useful and advanced methods for solving various types of integral and integro-differential equations in this book. The book is useful for graduate students, Ph.D. students, researchers and educators interested in mathematical modelling, applied mathematics, applied sciences,

engineering, etc. Key Features • New and advanced methods for solving integral and integro-differential equations • Contains comparison of various methods for accuracy • Demonstrates the applicability of integral and integro-differential equations in other scientific areas • Examines qualitative as well as quantitative properties of solutions of various types of integral and integro-differential equations

This volume presents a state-of-the-art account of the theory and applications of integral equations of convolution type, and of certain classes of integro-differential and non-linear integral equations. An extensive and well-motivated discussion of some open questions and of various important directions for further research is also presented. The book has been written so as to be self-contained, and includes a list of symbols with their definitions. For users of convolution integral equations, the volume contains numerous, well-classified inversion tables which correspond to the various convolutions and intervals of integration. It also has an extensive, up-to-date bibliography. The convolution integral equations which are considered arise naturally from a large variety of physical situations and it is felt that the types of solutions discussed will be usefull in many diverse disciplines of applied mathematics and mathematical physical. For researchers and graduate students in the mathematical and physical sciences whose work involves the solution of integral equations.

Inverse Problems for Fractional Diffusion Equations

Volterra Integral and Functional Equations

Scientific and Technical Revolution: Yesterday, Today and Tomorrow

The Stefan Samko Anniversary Volume

Numerical Analysis: Historical Developments in the 20th Century

Theorems, Analytic and Approximate Methods, Existence and Uniqueness of a Solution

Numerical Methods for Fractional Calculus presents numerical methods for fractional integrals and fractional derivatives, finite difference methods for fractional ordinary differential equations (FODEs) and fractional partial differential equations (FPDEs), and finite element methods for FPDEs.The book introduces the basic definitions and propertie

This book emphasizes in detail the applicability of the Optimal Homotopy Asymptotic Method to various engineering problems. It is a continuation of the book “Nonlinear Dynamical Systems in Engineering: Some Approximate Approaches”, published at Springer in 2011 and it contains a great amount of practical models from various fields of engineering such as classical and fluid mechanics, thermodynamics, nonlinear oscillations, electrical machines and so on. The main structure of the book consists of 5 chapters. The first chapter is introductory while the second chapter is devoted to a short history of the development of homotopy methods, including the basic ideas of the Optimal Homotopy Asymptotic Method. The last three chapters, from Chapter 3 to Chapter 5, are introducing three distinct alternatives of the Optimal Homotopy Asymptotic Method with illustrative applications to nonlinear dynamical systems. The third chapter deals with the first alternative of our approach with two iterations. Five applications are presented from fluid mechanics and nonlinear oscillations. The Chapter 4 presents the Optimal Homotopy Asymptotic Method with a single iteration and solving the linear equation on the first approximation. Here are treated 32 models from different fields of engineering such as fluid mechanics, thermodynamics, nonlinear damped and undamped oscillations, electrical machines and even from physics and biology. The last chapter is devoted to the Optimal Homotopy Asymptotic Method with a single iteration but without solving the equation in the first approximation.

Numerical analysis has witnessed many significant developments in the 20th century. This book brings together 16 papers dealing with historical developments, survey papers and papers on recent trends in selected areas of numerical analysis, such as: approximation and interpolation, solution of linear systems and eigenvalue problems, iterative methods, quadrature rules, solution of ordinary-, partial- and integral equations. The papers are reprinted from the 7-volume project of the Journal of Computational and Applied Mathematics on '/homepage/sac/cam/na2000/index.htmlNumerical Analysis 2000'. An introductory survey paper deals with the history of the first courses on numerical analysis in several countries and with the landmarks in the development of important algorithms and concepts in the field.

This book offers a comprehensive introduction to the theory of linear and nonlinear Volterra integral equations. It includes applications and an extensive bibliography.

An Introduction to Theory and Applications

Factorization, Singular Operators and Related Problems

Linear and Nonlinear Integral Equations

Existence and Stability

Abel Integral Equations

Principles of Differential and Integral Equations

These proceedings comprise a large part of the papers presented at the In ternational Conference Factorization, Singular Operators and related problems, which was held from January 28 to February 1, 2002, at the University of th Madeira, Funchal, Portugal, to mark Professor Georgii Litvinchuk's 70 birth day. Experts in a variety of fields came to this conference to pay tribute to the great achievements of Professor Georgii Litvinchuk in the development of vari ous areas of operator theory. The main themes of the conference were focussed around the theory of singular type operators and factorization problems, but other topics such as potential theory and fractional calculus, to name but a couple, were also presented. The goal of the conference was to bring together mathematicians from var ious fields within operator theory and function theory in order to highlight recent advances in problems many of which were originally studied by Profes sor Litvinchuk and his scientific school. A second aim was to stimulate in ternational collaboration even further and promote the interaction of different approaches in current research in these areas. The Proceedings will be of great interest to researchers in Operator The ory, Real and Complex Analysis, Functional and Harmonic Analysis, Potential Theory, Fractional Calculus and other areas, as well as to graduate students looking for the latest results.

This book offers a comprehensive treatment of the theory of measures of noncompactness. It discusses various applications of the theory of measures of noncompactness, in particular, by addressing the results and methods of fixed-point theory. The concept of a measure of noncompactness is very useful for the mathematical community working in nonlinear analysis. Both these theories are especially useful in investigations connected with differential equations, integral equations, functional integral equations and optimization theory. Thus, one of the book ' s central goals is to collect and present sufficient conditions for the solvability of such equations. The results are established in miscellaneous function spaces, and particular attention is paid to fractional calculus.

This book is a printed edition of the Special Issue "Mathematical Analysis and Applications" that was published in Axioms

The seven volumes LNCS 12249-12255 constitute the refereed proceedings of the 20th International Conference on Computational Science and Its Applications, ICCSA 2020, held in Cagliari, Italy, in July 2020. Due to COVID-19 pandemic the conference was organized in an online event. Computational Science is the main pillar of most of the present research, industrial and commercial applications, and plays a unique role in exploiting ICT innovative technologies. The 466 full papers and 32 short papers presented were carefully reviewed and selected from 1450 submissions. Apart from the general track, ICCSA 2020 also include 52 workshops, in various areas of computational sciences, ranging from computational science technologies, to specific areas of computational sciences, such as software engineering, security, machine learning and artificial intelligence, blockchain technologies, and of applications in many fields.

New Trends in Parameter Identification for Mathematical Models

Sequence Spaces and Measures of Noncompactness with Applications to Differential and Integral Equations

Topics in Integral and Integro-Differential Equations

Simulation, Identification, and Control

Integral Equations, Boundary Value Problems and Related Problems

Second Edition

This book presents a system view of the digital scientific and technological revolution, including its genesis and prerequisites, current trends, as well as current and potential issues and future prospects. It gathers selected research papers presented at the 12th International Scientific and Practical Conference, organized by the Institute of Scientific Communications. The conference “Artificial Intelligence: Anthropogenic Nature vs. Social Origin” took place on December 5–7, 2019 in Krasnoyarsk, Russia. The book is intended for academic researchers and independent experts studying the social and human aspects of the Fourth Industrial Revolution and the associated transition to the digital economy and Industry 4.0, as well as the creators of the legal framework for this process and its participants – entrepreneurs, managers, employees and consumers. It covers a variety of topics, including “intelligent” technologies and artificial intelligence, the digital economy, the social environment of the Fourth

Industrial Revolution and its consequences for humans, the regulatory framework of the Fourth Industrial Revolution, and the “green” consequences, prospects and financing of the Fourth Industrial Revolution.

This book contains new and useful materials concerning fuzzy fractional differential and integral operators and their relationship. As the title of the book suggests, the fuzzy subject matter is one of the most important tools discussed. Therefore, it begins by providing a brief but important and new description of fuzzy sets and the computational calculus they require. Fuzzy fractals and fractional operators have a broad range of applications in the engineering, medical and economic sciences. Although these operators have been addressed briefly in previous papers, this book represents the first comprehensive collection of all relevant explanations. Most of the real problems in the biological and engineering sciences involve dynamic models, which are defined by fuzzy fractional operators in the form of fuzzy fractional initial value problems. Another important goal of this book is to solve these systems and analyze their solutions both theoretically and numerically. Given the content covered, the book will benefit all researchers and students in the mathematical and computer sciences, but also the engineering sciences.

The Proceedings volume contains 16 contributions to the IMPA conference “New Trends in Parameter Identification for Mathematical Models”, Rio de Janeiro, Oct 30 – Nov 3, 2017, integrating the “Chemnitz Symposium on Inverse Problems on Tour”. This conference is part of the “Thematic Program on Parameter Identification in Mathematical Models” organized at IMPA in October and November 2017. One goal is to foster the scientific collaboration between mathematicians and engineers from the Brazialian, European and Asian communities. Main topics are iterative and variational regularization methods in Hilbert and Banach spaces for the stable approximate solution of ill-posed inverse problems, novel methods for parameter identification in partial differential equations, problems of tomography , solution of coupled conduction-radiation problems at high temperatures, and the statistical solution of inverse problems with applications in physics.