Singular Differential And Integral Equations With Applications 1st Edition

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Singular Differential And Integral Equations With Applications 1st Edition ***2020-10-02***

ARTHUR MCCULLOUGH

Lectures on Differential and Integral Equations Springer Nature
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 Padé 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.
Topics in Integral and Integro-Differential Equations Springer Science & Business Media
In preparing this translation for publication certain minor modifications and additions have been introduced into the original Russian text, in order to increase its readibility and usefulness. Thus, instead of the first person, the third person has been used throughout; wherever possible footnotes have been included with the main text. The chapters and their subsections of the Russian edition have been renamed parts and chapters respectively and the last have been numbered consecutively. An authors and subject index has been added. In particular, the former has been combined with the list of references of the original text, in order to enable the reader to find quickly all information on anyone reference in which he may be especially interested. This has been considered most important with a view to the difficulties experienced outside Russia in obtaining references, published in that country. Russian names have been printed in Russian letters in the authors index, in order to overcome any possible confusion arising from transliteration.
Theory & Technique WIT Press
The book deals with linear integral equations, that is, equations involving an unknown function which appears under the integral sign and contains topics such as Abel's integral equation, Volterra integral equations, Fredholm integral integral equations, singular and nonlinear integral equations, orthogonal systems of functions, Green's function as a symmetric kernel of the integral equations.
Integral Equations World Scientific Publishing Company
In the last century many problems which arose in the science, engineer ing and technology literature involved nonlinear complex phenomena. In many situations these natural phenomena give rise to (i). ordinary differ ential equations which are singular in the independent and/or dependent variables together with initial and boundary conditions, and (ii). Volterra and Fredholm type integral equations. As one might expect general exis tence results were difficult to establish for the problems which arose. Indeed until the early 1990's only very special examples were examined and these examples were usually tackled using some special device, which was usually only applicable to the particular problem under investigation. However in the 1990's new results in inequality and fixed point theory were used to present a very general existence theory for singular problems. This mono graph presents an up to date account of the literature on singular problems. One of our aims also is to present recent theory on singular differential and integral equations to a new and wider audience. The book presents a compact, thorough, and self-contained account for singular problems. An important feature of this book is that we illustrate how easily the theory can be applied to discuss many real world examples of current interest. In Chapter 1 we study differential equations which are singular in the independent variable. We begin with some standard notation in Section 1. 2 and introduce LP-Caratheodory functions. Some fixed point theorems, the Arzela- Ascoli theorem and Banach's theorem are also stated here.
Multidimensional Singular Integrals and Integral Equations Springer Science & Business Media
Multidimensional Singular Integrals and Integral Equations presents the results of the theory of multidimensional singular integrals and of equations containing such integrals. Emphasis is on singular integrals taken over Euclidean space or in the closed manifold of Liapounov and equations containing such integrals. This volume is comprised of eight chapters and begins with an overview of some theorems on linear equations in Banach spaces, followed by a discussion on the simplest properties of multidimensional singular integrals. Subsequent chapters deal with compounding of singular integrals; properties of the symbol, with particular reference to Fourier transform of a kernel

and the symbol of a singular operator; singular integrals in Lp spaces; and singular integral equations. The differentiation of integrals with a weak singularity is also considered, along with the rule for the multiplication of the symbols in the general case. The final chapter describes several applications of multidimensional singular integral equations to boundary problems in mathematical physics. This book will be of interest to mathematicians and students of mathematics.

Applied Singular Integral Equations Springer Science & Business Media

The present edition differs from the original German one mainly in the following addi tional material: weighted norm inequalities for maximal functions and singular opera tors (§ 12, Chap. XI), polysingular integral operators and pseudo-differential operators (§§ 7, 8, Chap. XII), and spline approximation methods for solving singular integral equations (§ 4, Chap. XVII). Furthermore, we added two subsections on polynomial approximation methods for singular integral equations over an interval or with dis continuous coefficients (Nos. 3.6 and 3.7, Chap. XVII). In many places we incorporated new results which, in the vast majority, are from the last five years after publishing the German edition (note that the references are enlarged by about 150 new titles). S. G. Mikhlin wrote §§ 7, 8, Chap. XII, and the other additions were drawn up by S. Prossdorf. We wish to express our deepest gratitude to Dr. A. Bottcher and Dr. R. Lehmann who together translated the text into English carefully and with remarkable expertise.

Approximation Methods for Solutions of Differential and Integral Equations Springer Science & Business Media

In analysing nonlinear phenomena many mathematical models give rise to problems for which only nonnegative solutions make sense. In the last few years this discipline has grown dramatically. This state-of-the-art volume offers the authors' recent work, reflecting some of the major advances in the field as well as the diversity of the subject. Audience: This volume will be of interest to graduate students and researchers in mathematical analysis and its applications, whose work involves ordinary differential equations, finite differences and integral equations.

Theory and Technique Springer Science & Business Media

Publisher Description

A New Class of Singular Integral Equations and Its Application to Differential Equations with Singular Coefficients CRC Press

Transmutations, Singular and Fractional Differential Equations with Applications to Mathematical Physics connects difficult problems with similar more simple ones. The book's strategy works for differential and integral equations and systems and for many theoretical and applied problems in mathematics, mathematical physics, probability and statistics, applied computer science and numerical methods. In addition to being exposed to recent advances, readers learn to use transmutation methods not only as practical tools, but also as vehicles that deliver theoretical insights. Presents the universal transmutation method as the most powerful for solving many problems in mathematics, mathematical physics, probability and statistics, applied computer science and numerical methods Combines mathematical rigor with an illuminating exposition full of historical notes and fascinating details Enables researchers, lecturers and students to find material under the single "roof"

Transmutations, Singular and Fractional Differential Equations with Applications to Mathematical Physics Courier Corporation

This book is the result of 20 years of investigations carried out by the author and his colleagues in order to bring closer and, to a certain extent, synthesize a number of well-known results, ideas and methods from the theory of function approximation, theory of differential and integral equations and numerical analysis. The book opens with an introduction on the theory of function approximation and is followed by a new approach to the Fredholm integral equations to the second kind. Several chapters are devoted to the construction of new methods for the effective approximation of solutions of several important integral, and ordinary and partial differential equations. In addition, new general results on the theory of linear differential equations with one regular singular point, as well as applications of the various new methods are discussed.

Singular Integral Equations Springer

Considers the class of singular integral equations on bounded two-dimensional multiply connected domains on the plane, and their applications to the theory of general elliptic systems of partial differential equations.

Positive Solutions of Differential, Difference and Integral Equations Elsevier

Many mathematical problems in science and engineering are defined by ordinary or partial differential equations with appropriate initial-boundary conditions. Among the various methods, boundary integral equation method (BIEM) is probably the most effective. It’s main advantage is that it changes a problem from its formulation in terms of unbounded differential operator to one for an integral/integro-differential operator, which makes the problem tractable from the analytical or numerical point of view. Basically, the review/study of the problem is shifted to a boundary (a relatively smaller domain), where it gives rise to integral equations defined over a suitable function space. Integral equations with singular kernels areamong the most important classes in the fields of elasticity, fluid mechanics, electromagnetics and other domains in applied science and engineering. With the advancesin computer technology, numerical simulations have become important tools in science and engineering. Several methods have been developed in numerical analysis for equations in mathematical models of applied sciences. Widely used methods include: Finite Difference Method (FDM), Finite Element Method (FEM), Finite Volume Method (FVM) and Galerkin Method (GM). Unfortunately, none of these are versatile. Each has merits and limitations. For example, the widely used FDM and FEM suffers from difficulties in problem solving when rapid changes appear in singularities. Even with the modern computing machines, analysis of shock-wave or crack propagations in three dimensional solids by the existing classical numerical schemes is challenging (computational time/memory requirements). Therefore, with the availability of faster computing machines, research into the development of new efficient schemes for approximate solutions/numerical simulations is an ongoing parallel activity. Numerical methods based on wavelet basis (multiresolution analysis) may be regarded as a confluence of widely used numerical schemes based on Finite Difference Method, Finite Element Method, Galerkin Method, etc. The objective of this monograph is to deal with numerical techniques to obtain (multiscale) approximate solutions in wavelet basis of different types of integral equations with kernels involving varieties of singularities appearing in the field of elasticity, fluid mechanics, electromagnetics and many other domains in applied science and engineering.

Introduction to Nonlinear Differential and Integral Equations Walter de Gruyter
Lucid, self-contained exposition of theory of ordinary differential equations and integral equations. Boundary value problem of second order linear ordinary differential equations, Fredholm integral equations, many other topics. Bibliography. 1960 edition.
Partial Differential and Integral Equations Springer Science & Business Media
/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.

Singular Integral Equations Hindawi Publishing Corporation

Many physical problems that are usually solved by differential equation methods can be solved more effectively by integral equation methods. Such problems abound in applied mathematics, theoretical mechanics, and mathematical physics. This uncorrected soft cover reprint of the second edition places the emphasis on applications and presents a variety of techniques with extensive examples.Originally published in 1971, Linear Integral Equations is ideal as a text for a beginning graduate level course. Its treatment of boundary value problems also makes the book useful to researchers in many applied fields.

Theory and Applications CRC Press

Singular Differential Equations and Special Functions is the fifth book within Ordinary Differential Equations with Applications to Trajectories and Vibrations, Six-volume Set. As a set they are the fourth volume in the series Mathematics and Physics Applied to Science and Technology. This fifth book consists of one chapter (chapter 9 of the set). The chapter starts with general classes of differential equations and simultaneous systems for which the properties of the solutions can be established 'a priori', such as existence and unicity of solution, robustness and uniformity with regard to changes in boundary conditions and parameters, and stability and asymptotic behavior. The book proceeds to consider the most important class of linear differential equations with variable coefficients, that can be analytic functions or have regular or irregular singularities. The solution of singular differential equations by means of (i) power series; (ii) parametric integral transforms; and (iii) continued fractions lead to more than 20 special functions; among these is given greater attention to generalized circular, hyperbolic, Airy, Bessel and hypergeometric differential equations, and the special functions that specify their solutions. Includes existence, unicity, robustness, uniformity, and other theorems for non-linear differential equations Discusses properties of dynamical systems derived from the differential equations describing them, using methods such as Liapunov functions Includes linear differential equations with periodic coefficients, including Floquet theory, Hill infinite determinants and multiple parametric resonance Details theory of the generalized Bessel differential equation, and of the generalized, Gaussian, confluent and extended hypergeometric functions and relations with other 20 special functions Examines Linear Differential Equations with analytic coefficients or regular or irregular singularities, and solutions via power series, parametric integral transforms, and continued fractions

Singular Integral Equations Walter de Gruyter GmbH & Co KG

This volume of the Proceedings of the congress ISAAC '97 collects the con tributions of the four sections 1. Function theoretic and functional analytic methods for pde, 2. Applications of function theory of several complex variables to pde, 3. Integral equations and boundary value problems, 4. Partial differential equations. Most but not all of the authors have participated in the congress. Unfortunately some from Eastern Europe and Asia have not managed to come because of lack of financial support. Nevertheless their manuscripts of the proposed talks are included in this volume. The majority of the papers deal with complex methods. Among them boundary value problems in particular the Riemann-Hilbert, the Riemann (Hilbert) and related problems are treated. Boundary behaviour of vector-valued functions are studied too. The Riemann-Hilbert problem is solved for elliptic complex equations, for mixed complex equations, and for several complex variables. It is considered in a general topological setting for mappings into q;n and related to Toeplitz operators. Convolution operators are investigated for nilpotent Lie groups leading to some consequences for the null space of the tangential Cauchy Riemann operator. Some boundary value problems for overdetermined systems in balls of q;n are solved explicitly. A survey is given for the Gauss-Manin connection associated with deformations of curve singularities. Several papers deal with generalizations of analytic functions with various applications to mathematical physics. Singular integrals in quaternionic anal ysis are studied which are applied to the time-harmonic Maxwell equations.

The Numerical Solution of Singular Integral Equations OUP Oxford

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.

Singular Differential and Integral Equations with Applications Cambridge University Press

This second edition of Linear Integral Equations continues the emphasis that the first edition placed on applications. Indeed, many more examples have been added throughout the text. Significant new material has been added in Chapters 6 and 8. For instance, in Chapter 8 we have included the solutions of the Cauchy type integral equations on the real line. Also, there is a section on integral equations with a logarithmic kernel. The bibliography at the end of the book has been exteded and brought up to date. I wish to thank Professor B.K. Sachdeva who has checked the revised man uscript and has suggested many improvements. Last but not least, I am grateful to the editor and staff of Birkhauser for inviting me to prepare this new edition and for their support in preparing it for publication. RamP Kanwal CHAYfERl Introduction 1.1. Definition An integral equation is an equation in which an unknown function appears under one or more integral signs Naturally, in such an equation there can occur other terms as well. For example, for a ~ s ~ b; a :(t :(b, the equations (1.1.1) f(s) = ib K(s, t)g(t)dt, g(s) = f(s) + ib K(s, t)g(t)dt, (1.1.2) g(s) = ib K(s, t)[g(t)fdt, (1.1.3) where the function g(s) is the unknown function and all the other functions are known, are integral equations. These functions may be complex-valued functions of the real variables s and t.

A New Class of Singular Integral Equations and Its Application to Differential Equations with Singular Coefficients Springer Science & Business Media

Authoritative, well-written treatment of extremely useful mathematical tool with wide applications. Topics include Volterra Equations, Fredholm Equations, Symmetric Kernels and Orthogonal Systems

of Functions, more. Advanced undergraduate to graduate level. Exercises. Bibliography.