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Invariants of Systems of Linear Differential Equations
Some Efficient Methods for Obtaining Infinite Series Solutions of N-th Order Linear Ordinary Differential Equations
Second Order Partial Differential Equations in Hilbert Spaces
Structure Of Solutions Of Differential Equations
Stochastic Differential Equations in Infinite Dimensions
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Measures and Differential Equations in Infinite-dimensional Space
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Analytic Pseudo-Differential Operators and their Applications
Differential Operators of Infinite Order with Real Arguments and Their Applications

Parabolic Equations on an Infinite Strip
Stochastic Partial Differential Equations in Infinite Dimensional Spaces

TALIYAH HEATH

Invariants of Systems of Linear Differential Equations Myers Press
The systematic study of existence, uniqueness, and properties of solutions to stochastic differential equations in infinite dimensions arising from practical problems characterizes this volume that is intended for graduate students and for pure and applied mathematicians, physicists, engineers, professionals working with mathematical models of finance. Major methods include compactness, coercivity, monotonicity, in a variety of set-ups. The authors emphasize the fundamental work of Gikhman and Skorokhod on the existence and uniqueness of solutions to stochastic differential equations and present its extension to infinite dimension. They also generalize the work of Khasminskii on stability and stationary distributions of solutions. New results, applications, and examples of stochastic partial differential equations are included. This clear and detailed presentation gives the basics of the infinite dimensional version of the classic books of Gikhman and Skorokhod and of Khasminskii in one concise volume that covers the main topics in infinite dimensional stochastic PDE's. By appropriate selection of material, the volume can be adapted for a 1- or 2-semester course, and can prepare the reader for research in this rapidly expanding area.
Some Efficient Methods for Obtaining Infinite Series Solutions of N-th Order Linear Ordinary Differential Equations Springer Science & Business Media
Among the topics covered in this classic treatment are linear differential equations; solution in an infinite form; solution by definite integrals; algebraic theory; Sturmian theory and its later developments; much more. "Highly recommended" — Electronics Industries.
Second Order Partial Differential Equations in Hilbert Spaces Courier Corporation
A systematic, self-contained treatment of the theory of stochastic differential equations in infinite dimensional spaces. Included is a discussion of Schwartz spaces of distributions in relation to probability theory and infinite dimensional stochastic analysis, as well as the random variables and stochastic processes that take values in infinite dimensional spaces.
Structure Of Solutions Of Differential Equations Springer
THE THEORY OF LINEAR OPERATORS FROM THE STANDPOINT OF DIFFEREN TIAL EQUATIONS OF INFINITE ORDER By HAROLD T. DAVIS INDIANA UNIVERSITY AND THE COWLES COMMISSION FOR RESEARCH IN ECONOMICS THE PRINCIPIA PRESS Bloommgton, Indiana 1936 MONOGRAPH OF THE WATERMAN INSTITUTE OF INDIANA UNIVERSITY CONTRIBUTION NO. 72 THE THEORY OF LINEAR OPERATORS To Agnes, who endured so patiently the writing of it, this boo is affectionately dedicated. TABLE OF CONTENTS CHAPTER I LINEAR OPERATORS 1. The Nature of Operators ----------1 2. Definition of an Operator -----.--3 3. A Classification of Operational Methods --------7 4. The Formal Theory of Operators ----------g 5. Generalized Integration and Differentiation - - 16 6. Differential and Integral Equations of Infinite Order -----23 7. The Generatrix Calculus - - 28 8. The Heaviside Operational Calculus ---------34 9. The Theory of Functionals ----------33 10. The Calculus of Forms in Infinitely Many Variables -----4 CHAPTER II PARTICULAR OPERATORS 1. Introduction ----------51 2. Polynomial Operators --------53 3. The Fourier Definition of an Operator ---------53 4. The Operational Symbol of von Neumann and Stone -----57 5. The Operator as a Laplace Transform --------59 6. Polar Operators ...-60 7. Branch Point Operators ----------64 8. Note on the Complementary Function ---------70 9. Riemanns Theory - .--.--72 10. Functions Permutable with Unity ----------76 11. Logarithmic Operators ----------78 12. Special Operators ----------85 13. The General Analytic Operator ----------99 14. The Differential Operator of Infinite Order -------100 15. Differential Operators as a Cauchy Integral -------103 16. The Generatrix of Differential Operators--------104 17. Five Operators of Analysis ----------105 CHAPTER III THE THEORY OF LINEAR SYSTEMS OF EQUATIONS 1. Preliminary Remarks ----------108 2. Types of Matrices ----------109 3. The Convergence of an Infinite Determinant -------114 4. The Upper Bound of a Determinant. Hadamards Theorem - - 116 5. Determinants which do not Vanish - - - - - - - - - 123 6. The Method of the Liouville-Neumann Series ----------126 7. The Method of Segments ----------130 8. Applications of the Method of Segments. ----------132 9. The Hilbert Theory of Linear Equations in an Infinite Number of Variables - - - - 137 10. Extension of the Foregoing Theory to Holder Space 149 vii VIII THE THEORY OF LINEAR OPERATORS CHAPTER IV OPERATIONAL MULTIPLICATION AND INVERSION 1. Algebra and Operators -------.. --153 2. The Generalized Formula of Leibnitz ---------154 3. Bourlets Operational Product --. 155 4. The Algebra of Functions of Composition --------159 5. Selected Problems in the Algebra of Permutable Functions - - - - 164 G. The Calculation of a Function Permutable with a Given Function - 166 7. The Transformation of Peres ----------171 8. The Permutability of Functions Permutable with a Given Function - 173 9. Permutable Functions of Second Kind - --176 10. The Inversion of Operators Bourlets Theory ------177 It. The Method of Successive Substitutions --------181 12. Some Further Properties of the Resolvent Generatrix - 185 13. The Inversion of Operators by Infinite Differentiation - 188 14. The Permutability of Linear PilYeiential Operators -----190 15. A Class of Non-permutable Operators ---------194 16. Special Examples Illustrating the Application of Operational Processes 200 CHAPTER V GRADESDEFINED BY SPECIAL OPERATORS 1. Definition ----------211 2. The Grade of an Unlimitedly Differentiable Function - 212 3. Functions of Finite Grade ----------215 4. Asymptotic Expansions --- 222 5. The Summability of Differential Operators with Constant Coefficients 230 6. The Summability of Operators of Laplace Type ------235 CHAPTER VI DIFFERENTIAL EQUATIONS OF INFINITE ORDER WITH CONSTANT COEFFICIENTS 1. Introduction ----------238 2. Expansion of the Resolvent Generatrix --------239 3. The Method of Cauchy-Bromwich ----------250 4...
Stochastic Differential Equations in Infinite Dimensions World Scientific
The articles in this volume reflect a subsequent development after a scientific meeting entitled Carleman Estimates and Control Theory, held in Cartona in September 1999. The 14 research-level articles, written by experts, focus on new results on Carleman estimates and their applications to uniqueness and controlla bility of partial differential equations and systems. The main topics are unique continuation for elliptic PDEs and systems, con trol theory and inverse problems. New results on strong uniqueness for second or higher order operators are explored in detail in several papers.

In the area of control theory. the reader will find applications of Carleman estimates to stabiliza tion, observability and exact control for the wave and the SchrOdinger equations. A final paper presents a challenging list of open problems on the topic of control lability of linear and sernilinear heat equations. The papers contain exhaustive and essentially self-contained proofs directly ac cessible to mathematicians, physicists, and graduate students with an elementary background in PDEs. Contributors are L. Aloui, M. Bellassoued, N. Burq, F. Colombini, B. Dehman, C. Grammatico, M. Khenissi, H. Koch, P. Le Borgne, N. Lerner, T. Nishitani. T. Okaji, K.D. Phung, R. Regbaoui, X. Saint Raymond, D. Tataru, and E. Zuazua.

Foundations of Stochastic Differential Equations in Infinite Dimensional Spaces Springer Science & Business Media

Preface; Existence for set Differential Equations via Multivalued Operator Equations; Nonlocal Cauchy Problem for Abstract Functional Integrodifferential Equations; Existence Results for Discontinuous Functional Evolution Equations in Abstract Spaces; A Generalised Solution of the Black-Scholes Partial Differential Equation; Optimality and Duality for Multiobjective Fractional Programming with Generalised Invexity; Markovian Approach to the Backward Recurrence Time; A Multiplicity Result of Singular Boundary Value Problems for Second Order Impulsive Differential Equations; Extremal Solutions of Initial Value Problem for Non-linear Second Order Impulsive Integro-Differential Equations of Volterra Type in Banach Spaces; Construction of Upper and Lower Solutions for Singular p-Laplacian Equations with Sign Changing Nonlinearities; A Qualitative Hamiltonian Model for Human Motion; ; Newton's Method for Matrix Polynomials; Admissibility and Non-Uniform Dichotomy for Differential Systems; Boundary Value Problems of Fuzzy Differential Equations on an Infinite Interval; An Ultimate Boundedness Result for a Certain System of Fourth Order Non-linear Differential Equations; The Initial Value Problems for the First Order System of Non-linear Impulsive Integro-Differential Equations; Generic Well-Posedness of Nonconvex Optimal Control Problems; Index.

Measures and Differential Equations in Infinite-dimensional Space SIAM

This research monograph brings together, for the first time, the varied literature on Yosida approximations of stochastic differential equations (SDEs) in infinite dimensions and their applications into a single cohesive work. The author provides a clear and systematic introduction to the Yosida approximation method and justifies its power by presenting its applications in some practical topics such as stochastic stability and stochastic optimal control. The theory assimilated spans more than 35 years of mathematics, but is developed slowly and methodically in digestible pieces. The book begins with a motivational chapter that introduces the reader to several different models that play recurring roles throughout the book as the theory is unfolded, and invites readers from different disciplines to see immediately that the effort required to work through the theory that follows is worthwhile. From there, the author presents the necessary prerequisite material, and then launches the reader into the main discussion of the monograph, namely, Yosida approximations of SDEs, Yosida approximations of SDEs with Poisson jumps, and their applications. Most of the results considered in the main chapters appear for the first time in a book form, and contain illustrative examples on stochastic partial differential equations. The key steps are included in all proofs, especially the various estimates, which help the reader to get a true feel for the theory of Yosida approximations and their use. This work is intended for researchers and graduate students in mathematics specializing in probability theory and will appeal to numerical analysts, engineers, physicists and practitioners in finance who want to apply the theory of stochastic evolution equations. Since the approach is based mainly in semigroup theory, it is amenable to a wide audience including non-specialists in stochastic processes.

Introduction to Ordinary Differential Equations Courier Corporation

A collection of papers on current topics and future problems in the theory of differential equations which were reported at the Taniguchi symposium (Katata) and RIMS symposium (Kyoto); Painlevé transcendents, Borel resummation, linear differential equations of infinite order, solvability of microdifferential equations, Gevrey index, etc. are among them.

Ordinary Differential Equations and Their Solutions Springer

Stochastic differential equations in infinite dimensional spaces are motivated by the theory and analysis of stochastic processes and by applications such as stochastic control, population biology, and turbulence, where the analysis and control of such systems involves investigating their stability. While the theory of such equations is well establ

Differential Equations with Discontinuous Coefficients Routledge

One service mathematics has rendered the 'Et moi ..., si j'avait su comment en revenir, je n'y serais point alle:' human race. It has put common sense back Jules Verne where it belongs, on the topmost shelf next to the dusty canister labelled 'discarded non- The series is divergent; therefore we may be sense'. able to do something with it. Eric T. Bell O. Heaviside Mathematics is a tool for thought. A highly necessary tool in a world where both feedback and non linearities abound. Similarly, all kinds of parts of mathematics serve as tools for other parts and for other sciences. Applying a simple rewriting rule to the quote on the right above one finds such statements as: 'One service topology has rendered mathematical physics ... '; 'One service logic has rendered com puter science .. .'; 'One service category theory has rendered mathematics ... '. All arguably true. And all statements obtainable this way form part of the raison d'elre of this series.

The Theory of Linear Operators from the Standpoint of Differential Equations of Infinite Order Springer

This book is devoted to the theory of infinite-order linear and nonlinear differential operators with several real arguments and their applications to problems of partial differential equations and numerical analysis.Part I develops the theory of pseudodifferential operators with real analytic symbols, the local representatives of which are linear differential operators of infinite order acting in the spaces of basic and generalized functions based on the duality of the spaces of real analytic functions and functionals. Applications to a variety of problems of PDEs and numerical analysis are given. Part II is devoted to the theory of Sobolev-Orlicz spaces of infinite order and the solvability of nonlinear partial differential equations with arbitrary nonlinearities.

Yosida Approximations of Stochastic Differential Equations in Infinite Dimensions and Applications Springer Science & Business Media

Infinite interval problems abound in nature and yet until now there has been no book dealing with such problems. The main reason for this seems to be that until the 1970's for the infinite interval problem all the theoretical results available required rather technical hypotheses and were

applicable only to narrowly defined classes of problems. Thus scientists mainly offer~d and used special devices to construct the numerical solution assuming tacitly the existence of a solution. In recent years a mixture of classical analysis and modern fixed point theory has been employed to study the existence of solutions to infinite interval problems. This has resulted in widely applicable results. This monograph is a cumulation mainly of the authors' research over a period of more than ten years and offers easily verifiable existence criteria for differential, difference and integral equations over the infinite interval. An important feature of this monograph is that we illustrate almost all the results with examples. The plan of this monograph is as follows. In Chapter 1 we present the existence theory for second order boundary value problems on infinite intervals. We begin with several examples which model real world phenom ena. A brief history of the infinite interval problem is also included. We then present general existence results for several different types of boundary value problems. Here we note that for the infinite interval problem only two major approaches are available in the literature.

Elementary Differential Equations with Linear Algebra CRC Press

This treatment presents most of the methods for solving ordinary differential equations and systematic arrangements of more than 2,000 equations and their solutions. The material is organized so that standard equations can be easily found. Plus, the substantial number and variety of equations promises an exact equation or a sufficiently similar one. 1960 edition.

Carleman Estimates and Applications to Uniqueness and Control Theory Cambridge University Press

Introduction to Ordinary Differential Equations, Second Edition provides an introduction to differential equations. This book presents the application and includes problems in chemistry, biology, economics, mechanics, and electric circuits. Organized into 12 chapters, this edition begins with an overview of the methods for solving single differential equations. This text then describes the important basic properties of solutions of linear differential equations and explains higher-order linear equations. Other chapters consider the possibility of representing the solutions of certain linear differential equations in terms of power series. This book discusses as well the important properties of the gamma function and explains the stability of solutions and the existence of periodic solutions. The final chapter deals with the method for the construction of a solution of the integral equation and explains how to establish the existence of a solution of the initial value system. This book is a valuable resource for mathematicians, students, and research workers.

Topics in Fractional Differential Equations Nova Publishers

This book focuses on solutions of second order, linear, parabolic, partial differentialequations on an infinite strip-emphasizing their integral representation, their initialvalues in several senses, and the relations between these.Parabolic Equations on an Infinite Strip provides valuable information-previously unavailable in a single volume-on such topics as semigroup property.. . the Cauchy problem ... Gauss-Weierstrass representation . .. initial limits .. .normal limits and related representation theorems ... hyperplane conditions .. .determination of the initial measure .. . and the maximum principle. It also exploresnew, unpublished results on parabolic limits . . . more general limits ... and solutionssatisfying LP conditions.Requiring only a fundamental knowledge of general analysis and measure theory, thisbook serves as an excellent text for graduate students studying partial differentialequations and harmonic analysis, as well as a useful reference for analysts interested inapplied measure theory, and specialists in partial differential equations.

The Theory of Linear Operations from the Standpoint of Differential Equations of Infinite Order by Harold T. Davis and the Cowles Commission for Research in Economics Springer

Contents: Some ExamplesLinear ProblemsGreen's FunctionMethod of Complementary FunctionsMethod of AdjointsMethod of ChasingSecond Order EquationsError Estimates in Polynomial InterpolationExistence and UniquenessPicard's and Approximate Picard's MethodQuasilinearization and Approximate QuasilinearizationBest Possible Results: Weight Function TechniqueBest Possible Results: Shooting MethodsMonotone Convergence and Further ExistenceUniqueness Implies ExistenceCompactness Condition and Generalized SolutionsUniqueness Implies UniquenessBoundary Value FunctionsTopological MethodsBest Possible Results: Control Theory MethodsMatching MethodsMaximal SolutionsMaximum PrincipleInfinite Interval ProblemsEquations with Deviating Arguments Readership: Graduate students, numerical analysts as well as researchers who are studying open problems. Keywords:Boundary Value Problems;Ordinary Differential Equations;Green's Function;Quasilinearization;Shooting Methods;Maximal Solutions;Infinite Interval Problems

Differential Operators and Differential Equations of Infinite Order with Constant Coefficients World Scientific

In recent years, mathematicians have detailed simpler proofs of known theorems, have identified new applications of the method of averaging, and have obtained many new results of these applications. Encompassing these novel aspects, Method of Averaging of the Infinite Interval: Theory and Applications rigorously explains the modern theory of the method of averaging and provides a solid understanding of the results obtained when applying this theory. The book starts with the less complicated theory of averaging linear differential equations (LDEs), focusing on almost periodic functions. It describes stability theory and Shtokalo's method, and examines various applications, including parametric resonance and the construction of asymptotics. After establishing this foundation, the author goes on to explore nonlinear equations. He studies standard form systems in which the right-hand side of a system is proportional to a small parameter and proves theorems similar to Banfi's theorem. The final chapters are devoted to systems with a rapidly rotating phase. Covering an important asymptotic method of differential equations, this book provides a thorough understanding of the method of averaging theory and its resulting applications.

Functional Differential Equations with Infinite Delay World Scientific

Topics in Fractional Differential Equations is devoted to the existence and uniqueness of solutions for various classes of Darboux problems for hyperbolic differential equations or inclusions involving the Caputo fractional derivative. Fractional calculus generalizes the integrals and derivatives to non-integer orders. During the last decade, fractional calculus was found to play a fundamental role in the modeling of a considerable number of phenomena; in particular the modeling of memory-dependent and complex media such as porous media. It has emerged as an important tool for the study of dynamical systems where classical methods reveal strong limitations. Some equations present delays which may be finite, infinite, or state-dependent. Others are subject to an impulsive effect. The above problems are studied using the fixed point approach, the method of upper and lower solution, and the Kuratowski measure of noncompactness. This book is addressed to a wide

audience of specialists such as mathematicians, engineers, biologists, and physicists.
Expansions in Series of Solutions of Linear Difference-differential and Infinite Order Differential Equations with Constant Coefficients World Scientific Publishing Company
Second order linear parabolic and elliptic equations arise frequently in mathematics and other disciplines. For example parabolic equations are to be found in statistical mechanics and solid state theory, their infinite dimensional counterparts are important in fluid mechanics, mathematical finance and population biology, whereas nonlinear parabolic equations arise in control theory. Here the authors present a state of the art treatment of the subject from a new perspective. The main tools used are probability measures in Hilbert and Banach spaces and stochastic evolution equations. There is then a discussion of how the results in the book can be applied to control theory. This area is developing very rapidly and there are numerous notes and references that point the reader to more specialised results not covered in the book. Coverage of some essential background material will help make the book self-contained and increase its appeal to those entering the subject.

Representation and Control of Infinite Dimensional Systems Academic Press
The main objective of this monograph is the study of a class of stochastic differential systems having unbounded coefficients, both in finite and in infinite dimension. We focus our attention on the regularity properties of the solutions and hence on the smoothing effect of the corresponding transition semigroups in the space of bounded and uniformly continuous functions. As an application of these results, we study the associated Kolmogorov equations, the large-time behaviour of the solutions and some stochastic optimal control problems together with the corresponding Hamilton-Jacobi-Bellman equations. In the literature there exists a large number of works (mostly in finite dimen sion) dealing with these arguments in the case of bounded Lipschitz-continuous coefficients and some of them concern the case of coefficients having linear growth. Few papers concern the case of non-Lipschitz coefficients, but they are mainly re lated to the study of the existence and the uniqueness of solutions for the stochastic system. Actually, the study of any further properties of those systems, such as their regularizing properties or their ergodicity, seems not to be developed widely enough. With these notes we try to cover this gap.