Power Series Solutions Differential Equations

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Generalized Power Series Solutions to Linear Partial Differential Equations

PEREZ MCNEIL

Some Efficient Methods for Obtaining Infinite Series Solutions of N-th Order Linear Ordinary Differential Equations
Princeton University Press
The use of the theta-operator method and generalized hypergeometric functions in obtaining solutions to nth-order linear ordinary differential equations is explained. For completeness, the analysis of the differential equation to determine whether the point of expansion is an ordinary point or a regular singular point is included. The superiority of the two methods shown over the standard method is demonstrated by using all three of the methods to work out several examples. Also included is a compendium of formulae and properties of the theta operator and generalized hypergeometric functions which is complete enough to make the report self-contained.
Basic Theory

of Ordinary Differential Equations CRC Press Designed to introduce students to the theory and applications of differential equations and to help them formulate scientific problems in terms of such equations, this undergraduat e-level text emphasizes applications to problems in biology, economics, engineering, and physics. This edition also includes material on discontinuous solutions, Riccati and Euler equations, and linear difference equations. *Formal And Analytic Solutions Of Differential Equations* Springer Science & Business Media Applying Power Series to Differential EquationsSpri nger Nature *Power Series Solutions to Ordinary Differential Equations* Academic Press After presenting a review of valuation theory and elementary p-adic analysis together with an application to the congruence zeta function, this book offers a detailed study of the p-adic properties of formal power series solutions of linear differential equations. In particular, the p-adic radii of convergence and the p-adic growth of coefficients are studied. Recent work of Christol, Bombieri, André, and Dwork is treated and augmented. The book

concludes with Chudnovsky's theorem: the analytic continuation of a G -series is again a G -series. This book will be indispensable for those wishing to study the work of Bombieri and André on global relations and for the study of the arithmetic properties of solutions of ordinary differential equations. *The Convergence of Power Series Solutions to Second-order Linear Differential Equations* CRC Press Written for advanced undergraduate and first-year graduate students, this book aims to introduce students to a serious level of p-adic analysis with important implications for number theory. The main object is the study of G-series, that is, power series y=aij=0 Ajxj with coefficients in an algebraic number field K. These series satisfy a linear differential equation Ly=0 with LIK(x) [d/dx] and have non-zero radii of convergence for each imbedding of K into the complex numbers. They have the further property that the common denominators of the first s coefficients go to infinity geometrically with the index s. After presenting a review of valuation theory and elementary p-adic analysis together with an application

to the congruence zeta function, this book offers a detailed study of the p-adic properties of formal power series solutions of linear differential equations. In particular, the p-adic radii of convergence and the p-adic growth of coefficients are studied. Recent work of Christol, Bombieri, André, and Dwork is treated and augmented. The book concludes with Chudnovsky's theorem: the analytic continuation of a G -series is again a G -series. This book will be indispensable for those wishing to study the work of Bombieri and André on global relations and for the study of the arithmetic properties of solutions of ordinary differential equations.

Power series solutions of algebraic differential equations

PWS Publishing Company

This book presents a modern introduction to analytical and numerical techniques for solving ordinary differential equations (ODEs). Contrary to the traditional format—the theorem-and-proof format—the book is focusing on analytical and numerical methods. The book supplies a variety of problems and examples, ranging from the elementary to the advanced level, to

introduce and study the mathematics of ODEs. The analytical part of the book deals with solution techniques for scalar first-order and second-order linear ODEs, and systems of linear ODEs—with a special focus on the Laplace transform, operator techniques and power series solutions. In the numerical part, theoretical and practical aspects of Runge-Kutta methods for solving initial-value problems and shooting methods for linear two-point boundary-value problems are considered. The book is intended as a primary text for courses on the theory of ODEs and numerical treatment of ODEs for advanced undergraduate and early graduate students. It is assumed that the reader has a basic grasp of elementary calculus, in particular methods of integration, and of numerical analysis. Physicists, chemists, biologists, computer scientists and engineers whose work involves solving ODEs will also find the book useful as a reference work and tool for independent study. The book has been prepared within the framework of a German–Iranian research project on mathematical methods for ODEs, which was started in

early 2012.

Ordinary Differential Equations and Calculus of Variations

Applying Power Series to Differential Equations

Differential equations is one of the oldest subjects in modern mathematics. It was not long after Newton and Leibniz invented the calculus that Bernoulli and Euler and others began to consider the heat equation and the wave equation of mathematical physics. Newton himself solved differential equations both in the study of planetary motion and also in his consideration of optics. Today differential equations is the centerpiece of much of engineering, of physics, of significant parts of the life sciences, and in many areas of mathematical modeling. This text describes classical ideas and provides an entree to the newer ones. The author pays careful attention to advanced topics like the Laplace transform, Sturm–Liouville theory, and boundary value problems (on the traditional side) but also pays due homage to nonlinear theory, to modeling, and to computing (on the modern side). This book began as a modernization of George Simmons' classic, Differential Equations with Applications and Historical

Notes. Prof. Simmons invited the author to update his book. Now in the third edition, this text has become the author's own and a unique blend of the traditional and the modern. The text describes classical ideas and provides an entree to newer ones. Modeling brings the subject to life and makes the ideas real. Differential equations can model real life questions, and computer calculations and graphics can then provide real life answers. The symbiosis of the synthetic and the calculational provides a rich experience for students, and prepares them for more concrete, applied work in future courses. Additional Features Anatomy of an Application sections. Historical notes continue to be a unique feature of this text. Math Nuggets are brief perspectives on mathematical lives or other features of the discipline that will enhance the reading experience. Problems for Review and Discovery give students some open-ended material for exploration and further learning. They are an important means of extending the reach of the text, and for anticipating future work. This new edition is re-organized to make it more useful and more accessible. The most

frequently taught topics are now up front. And the major applications are isolated in their own chapters. This makes this edition the most useable and flexible of any previous editions.

Multisummability of Formal Power Series Solutions of Linear Ordinary Differential Equations

Academic Press

This book presents a complete theory of ordinary differential equations, with many illustrative examples and interesting exercises. A rigorous treatment is offered in this book with clear proofs for the theoretical results and with detailed solutions for the examples and problems. This book is intended for undergraduate students who major in mathematics and have acquired a prerequisite knowledge of calculus and partly the knowledge of a complex variable, and are now reading advanced calculus and linear algebra. Additionally, the comprehensive coverage of the theory with a wide array of examples and detailed solutions, would appeal to mathematics graduate students and researchers as well as graduate students in majors of other disciplines. As a handy reference, advanced knowledge is

provided in this book with details developed beyond the basics; optional sections, where main results are extended, offer an understanding of further applications of ordinary differential equations.

An Introduction to G-functions

Princeton University Press

Providing readers with the very basic knowledge necessary to begin research on differential equations with professional ability, the selection of topics here covers the methods and results that are applicable in a variety of different fields. The book is divided into four parts. The first covers fundamental existence, uniqueness, smoothness with respect to data, and nonuniquenes s. The second part describes the basic results concerning linear differential equations, while the third deals with nonlinear equations. In the last part the authors write about the basic results concerning power series solutions. Each chapter begins with a brief discussion of its contents and history, and hints and comments for many problems are given throughout. With 114 illustrations and 206 exercises, the book is suitable for a one-year graduate

course, as well as a reference book for research mathematicians.

Power Series Solutions of Partial Differential Equations

John Wiley & Sons

The book provides the reader with an overview of the actual state of research in ordinary and partial differential equations in the complex domain. Topics include summability and asymptotic study of both ordinary and partial differential equations, and also q-difference and differential-difference equations. This book will be of interest to researchers and students who wish to expand their knowledge of these fields.With the latest results and research developments and contributions from experts in their field, Formal and Analytic Solutions of Differential Equations provides a valuable contribution to methods, techniques, different mathematical tools, and study calculations.

Singular Nonlinear Partial Differential Equations

Brooks/Cole

This book is aimed to undergraduate STEM majors and to researchers using ordinary differential equations. It covers a wide range of STEM-oriented differential equation problems that can be solved using computational power series

methods. Many examples are illustrated with figures and each chapter ends with discovery/research questions most of which are accessible to undergraduate students, and almost all of which may be extended to graduate level research. Methodologies implemented may also be useful for researchers to solve their differential equations analytically or numerically. The textbook can be used as supplementary for undergraduate coursework, graduate research, and for independent study. *Theory and Examples of Ordinary Differential Equations* Springer Science & Business Media This book is intended to serve as a text for a first course on differential equations. It provides more than enough material for a one-semester course. The book is a much shortened version of the author's Ordinary Differential Equations (525 pp., Addison-Wesley Publishing Company 1958). The principal differences are as follows: the section on matrices and the chapters on exact differential equations of higher order, phase plane analysis, and fundamental theory (proofs of existence theorems) are omitted; the treatment of linear

equations from the point of view of the systems designer (input-output analysis) is considerably abbreviated; the material is regrouped in 10 short chapters. With all these changes, the present volume still retains the principal aspects of the longer work: the emphasis on gaining insight and understanding as opposed to pure manipulative skill; the use of physical examples both as illustrations of the mathematical methods and as aids to understanding these methods. Chapter 1 presents the important concepts and the main problems. By a study of simple numerical methods, an understanding of the existence theorem is gained. Chapter 2, devoted to equations of first order and first degree, gives some special procedures for solving problems in explicit form but also emphasizes understanding the processes. Chapter 3 gives a number of applications of first order equations; for the linear equations, some discussion of the systems point of view is given. Chapter 4 considers linear equations of arbitrary order, presents the main theorems, and methods for equations with constant coefficients; additional

methods, based on differential operators and Laplace transforms, are given in Chapter 5. Chapter 6 treats applications of linear equations, including such topics as stability, transients, response to sinusoidal forcing functions, with illustrations in mechanics and circuit theory. Chapter 7 is devoted to simultaneous linear equations, with emphasis on the method of exponential substitution; operational methods are also introduced; applications are treated briefly. Chapter 8 discusses equations not of first degree and introduces the concept of singular solution. Chapter 9 covers power series solutions, and includes solution of linear equations at regular singular points. *Introduction to Differential Equations* Springer Science & Business Media Though ordinary differential equations is taught as a core course to students in mathematics and applied mathematics, detailed coverage of the topics with sufficient examples is unique. Written by a mathematics professor and intended as a textbook for third- and fourth-year undergraduates, the five chapters of this publication

give a precise account of higher order differential equations, power series solutions, special functions, existence and uniqueness of solutions, and systems of linear equations. Relevant motivation for different concepts in each chapter and discussion of theory and problems-without the omission of steps-sets Ordinary Differential Equations: A First Course apart from other texts on ODEs. Full of distinguishing examples and containing exercises at the end of each chapter, this lucid course book will promote self-study among students.

Ordinary Differential Equations with Modern Applications

Research & Education Assoc.

Ordinary differential equations - the building blocks of mathematical modelling - are also key elements of disciplines as diverse as engineering and economics. While mastery of these equations is essential, adhering to any one method of solving them is not: this book stresses alternative examples and analyses by means of which the student can build an understanding of a number of approaches to finding solutions and understanding their behaviour. This book offers not only an applied perspective

for the student learning to solve differential equations, but also the challenge to apply these analytical tools in the context of singular perturbations, which arises in many areas of application. An important resource for the advanced undergradute, this book would be equally useful for the beginning graduate student investigating further approaches to these essential equations.

Differential Equations with Maple V®
Cambridge University Press

The aim of this book is to put together all the results that are known about the existence of formal, holomorphic and singular solutions of singular non linear partial differential equations.

Introduction to Ordinary Differential Equations with Mathematica
Academic Press

Simple Ordinary Differential Equations may have solutions in terms of power series whose coefficients grow at such a rate that the series has a radius of convergence equal to zero. In fact, every linear meromorphic system has a formal solution of a certain form, which can be relatively easily computed, but which generally involves such power series diverging everywhere. In this book

the author presents the classical theory of meromorphic systems of ODE in the new light shed upon it by the recent achievements in the theory of summability of formal power series. Introduction to Ordinary Differential Equations Springer Cover -- Half Title -- Series Page -- Title Page -- Copyright Page -- Dedication -- Contents -- Preface -- Author -- 1. What is a Differential Equation? -- 1.1. Introductory Remarks -- 1.2. A Taste of Ordinary Differential Equations -- 1.3. The Nature of Solutions -- 2. Solving First-Order Equations -- 2.1. Separable Equations -- 2.2. First-Order Linear Equations -- 2.3. Exact Equations -- 2.4. Orthogonal Trajectories and Families -- 2.5. Homogeneous Equations -- 2.6. Integrating Factors -- 2.7. Reduction of Order -- 2.7.1. Dependent Variable Missing -- 2.7.2. Independent Variable Missing -- 3. Some Applications of the First-Order Theory -- 3.1. The Hanging Chain and Pursuit Curves -- 3.1.1. The Hanging Chain -- 3.1.2. Pursuit Curves -- 3.2. Electrical Circuits -- 4. Second-Order Linear Equations -- 4.1. Second-Order Linear Equations with Constant Coefficients -- 4.2. The Method of

Undetermined Coefficients -- 4.3. The Method of Variation of Parameters -- 4.4. The Use of a Known Solution to Find Another -- 4.5. Higher-Order Equations -- 5. Applications of the Second-Order Theory -- 5.1. Vibrations and Oscillations -- 5.1.1. Undamped Simple Harmonic Motion -- 5.1.2. Damped Vibrations -- 5.1.3. Forced Vibrations -- 5.1.4. A Few Remarks about Electricity -- 5.2. Newton's Law of Gravitation and Kepler's Laws -- 5.2.1. Kepler's Second Law -- 5.2.2. Kepler's First Law -- 5.2.3. Kepler's Third Law -- 6. Power Series Solutions and Special Functions -- 6.1. Introduction and Review of Power Series -- 6.1.1. Review of Power Series -- 6.2. Series Solutions of First-Order Equations -- 6.3. Ordinary Points -- 6.4. Regular Singular Points -- 6.5. More on Regular Singular Points -- 7. Fourier Series: Basic Concepts -- 7.1. Fourier Coefficients -- 7.2. Some Remarks about Convergence -- 7.3. Even and Odd Functions: Cosine and Sine Series.

Differential Equations

World Scientific

Here's the perfect self-teaching guide to help anyone master differential equations--a common stumbling block for

students looking to progress to advanced topics in both science and math. Covers First Order Equations, Second Order Equations and Higher, Properties, Solutions, Series Solutions, Fourier Series and Orthogonal Systems, Partial Differential Equations and Boundary Value Problems, Numerical Techniques, and more.

Differential Equations

Springer Science & Business Media

This book is meant to be a text which can be used for a first course in ordinary differential equations. The student is assumed to have a knowledge of calculus but not what is usually called advanced calculus. The aim is to give an elementary, thorough systematic introduction to the subject. All significant results are stated as theorems, and careful proofs are given. The exercises in the book serve two purposes: to develop the student's technique in solving equations, or to help sharpen the student's understanding of the mathematical structure of the subject. The exercises also introduce the student to a variety of topics not treated in the text: stability, equations with periodic coefficients, and boundary value problems.

An

Introduction to G-Functions. (AM-133), Volume 133 Springer Nature

REA’s Problem Solvers is a series of useful, practical, and informative study guides. Each title in the series is complete step-by-step solution guide. The Differential Equations Problem Solver enables students to solve difficult problems by showing them step-by-step solutions to Differential Equations problems. The Problem Solvers cover material ranging from the elementary to the advanced and make excellent review books and textbook companions. They're perfect for undergraduate and graduate studies. The Differential Equations Problem Solver is the perfect resource for any class, any exam, and any problem.

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