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Practical MATLAB Modeling with Simulink Courier Dover Publications
Covid-19 is primarily a respiratory disease which results in impaired oxygenation of blood. The O2-deficient blood then moves through the body, and for the study in this book, the focus is on the blood flowing to the brain. The dynamics of blood flow along the brain capillaries and tissue is modeled as systems of

ordinary and partial differential equations (ODE/PDEs). The ODE/PDE methodology is presented through a series of examples, 1. A basic one PDE model for O2 concentration in the brain capillary blood. 2. A two PDE model for O2 concentration in the brain capillary blood and in the brain tissue, with O2 transport across the blood brain barrier (BBB). 3. The two model extended to three PDEs to include the brain functional neuron cell density. Cognitive impairment could result from reduced neuron cell density in time and space (in the brain) that follows from lowered O2 concentration (hypoxia). The computer-based implementation of the example models is presented through routines coded (programmed) in R, a quality, open-source scientific computing system that is readily available from the Internet. Formal mathematics is minimized, e.g., no theorems and proofs. Rather, the presentation is through detailed examples that the reader/researcher/analyst can execute on modest computers. The PDE analysis is based on the method of lines (MOL), an established general algorithm for PDEs, implemented with finite differences. The routines are available from a download link so that the example models can be executed without having to first study numerical methods and computer coding. The routines can then be applied to variations and extensions of the blood/brain hypoxia models, such as changes in the ODE/PDE parameters (constants) and form of the model equations.

Introduction to Partial Differential Equations with Applications

CRC Press
Tremendous response from teachers and students to the last edition of this book has necessiated the revision of the book in a very short span of time.The present edition has been throughly revised and enlarged.Many new important topics have been added at proper places.Latest papers of I.A.S. and many Indian Universities have been solved at appropriate places.

Applications of Lie Groups to Differential Equations Springer Science & Business Media
Partial differential equations (PDEs) are one of the most used widely forms of mathematics in science and engineering. PDEs can have partial derivatives with respect to (1) an initial value variable, typically time, and (2) boundary value variables, typically spatial variables. Therefore, two fractional PDEs can be considered, (1) fractional in time (TFPDEs), and (2) fractional in space (SFPDEs). The two volumes are directed

to the development and use of SFPDEs, with the discussion divided as: Vol 1: Introduction to Algorithms and Computer Coding in R Vol 2: Applications from Classical Integer PDEs. Various definitions of space fractional derivatives have been proposed. We focus on the Caputo derivative, with occasional reference to the Riemann-Liouville derivative. Partial differential equations (PDEs) are one of the most used widely forms of mathematics in science and engineering. PDEs can have partial derivatives with respect to (1) an initial value variable, typically time, and (2) boundary value variables, typically spatial variables. Therefore, two fractional PDEs can be considered, (1) fractional in time (TFPDEs), and (2) fractional in space (SFPDEs). The two volumes are directed to the development and use of SFPDEs, with the discussion divided as: Vol 1: Introduction to Algorithms and Computer Coding in R Vol 2: Applications from Classical Integer PDEs. Various definitions of space fractional derivatives have been proposed. We focus on the Caputo derivative, with occasional reference to the Riemann-Liouville derivative. The Caputo derivative is defined as a convolution integral. Thus, rather than being local (with a value at a particular point in space), the Caputo derivative is non-local (it is based on an integration in space), which is one of the reasons that it has properties not shared by integer derivatives. A principal objective of the two volumes is to provide the reader with a set of documented R routines that are discussed in detail, and can be downloaded and executed without having to first study the details of the relevant numerical analysis and then code a set of routines. In the first volume, the emphasis is on basic concepts of SFPDEs and the associated numerical algorithms. The presentation is not as formal mathematics, e.g., theorems and proofs. Rather, the presentation is by examples of SFPDEs, including a detailed discussion of the algorithms for computing numerical solutions to SFPDEs and a detailed explanation of the associated source code.

Ordinary and Partial Differential Equations
Morgan & Claypool Publishers
This text explores the essentials of partial differential equations as applied to engineering and the physical sciences. Discusses ordinary differential equations, integral curves and surfaces of vector fields, the Cauchy-Kovalevsky theory, more. Problems and answers.

PDE Models for Atherosclerosis Computer Implementation in R
Springer Science & Business Media
Concise text derives

common partial differential equations, discussing and applying techniques of Fourier analysis. Also covers Legendre, Bessel, and Mathieu functions and general structure of differential operators. 1953 edition.
Ordinary and Partial Differential Equations Courier Corporation Although the Partial Differential Equations (PDE) models that are now studied are usually beyond traditional mathematical analysis, the numerical methods that are being developed and used require testing and validation. This is often done with PDEs that have known, exact, analytical solutions. The development of analytical solutions is also an active area of research, with many advances being reported recently, particularly traveling wave solutions for nonlinear evolutionary PDEs. Thus, the current development of analytical solutions directly supports the development of numerical methods by providing a spectrum of test problems that can be used to evaluate numerical methods. This book surveys some of these new developments in analytical and numerical methods, and relates the two through a series of PDE examples. The PDEs that have been selected are largely "named'' since they carry the names of their original contributors. These names usually signify that the PDEs are

widely recognized and used in many application areas. The authors’ intention is to provide a set of numerical and analytical methods based on the concept of a traveling wave, with a central feature of conversion of the PDEs to ODEs. The Matlab and Maple software will be available for download from this website shortly. www.pdecomp.net Includes a spectrum of applications in science, engineering, applied mathematics Presents a combination of numerical and analytical methods Provides transportable computer codes in Matlab and Maple

Finite Difference Methods for

Ordinary and Partial Differential Equations

S. Chand

Partial differential equations (PDEs) are one of the most used widely forms of mathematics in science and engineering. PDEs can have partial derivatives with respect to (1) an initial value variable, typically time, and (2) boundary value variables, typically spatial variables. Therefore, two fractional PDEs can be considered, (1) fractional in time (TFPDEs), and (2) fractional in space (SFPDEs). The two volumes are directed to the development and use of SFPDEs, with the discussion divided as: Vol 1:

Introduction to Algorithms and Computer Coding in R Vol 2: Applications from Classical Integer PDEs. Various definitions of space fractional derivatives have been proposed. We focus on the Caputo derivative, with occasional reference to the Riemann-Liouville derivative. In the second volume, the emphasis is on applications of SFPDEs developed mainly through the extension of classical integer PDEs to SFPDEs. The example applications are: Fractional diffusion equation with Dirichlet, Neumann and Robin boundary conditions Fisher-Kolmogorov SFPDE Burgers SFPDE Fokker-Planck SFPDE Burgers-Huxley SFPDE Fitzhugh-Nagumo SFPDE /div These SFPDEs were selected because they are integer first order in time and integer second order in space. The variation in the spatial derivative from order two (parabolic) to order one (first order hyperbolic) demonstrates the effect of the spatial fractional order with 1 ≤ ≤ 2. All of the example SFPDEs are one dimensional in Cartesian coordinates. Extensions to higher dimensions and other coordinate systems, in principle, follow from the examples in this second volume. The examples start with a statement of the integer PDEs that are then extended to SFPDEs. The format of each chapter is the same as in the first volume. The R routines can be downloaded and executed on a modest computer (R is readily available from the Internet). Numerical Integration of Space Fractional Partial Differential Equations Apress Partial Differential Equations presents a balanced and comprehensive introduction to the concepts and techniques required to solve problems containing unknown functions of multiple variables. While focusing on the three most classical partial differential equations (PDEs)—the wave, heat, and Laplace equations—this detailed text also presents a broad practical perspective that merges mathematical concepts with real-world application in diverse areas including molecular structure, photon and electron interactions, radiation of electromagnetic waves, vibrations of a solid, and many more. Rigorous pedagogical tools aid in student comprehension; advanced topics are introduced frequently, with minimal technical jargon, and a wealth of exercises reinforce vital skills and invite additional self-study. Topics are presented in a logical progression, with major concepts such as wave propagation, heat and diffusion, electrostatics, and quantum mechanics placed in contexts familiar to students of various fields in science and engineering. By understanding the properties and applications of PDEs, students will be equipped to better analyze and interpret central processes of the natural world.

A Course in Ordinary and Partial Differential Equations

Springer
lead the reader to a theoretical understanding of the subject without neglecting its practical aspects. The outcome is a textbook that is mathematically honest and rigorous and provides its target audience with a wide range of skills in both ordinary and partial differential equations." --Book Jacket.

Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB

Springer Nature
This book provides a set of ODE/PDE integration routines in the six most widely used computer languages, enabling scientists and engineers to apply ODE/PDE analysis toward solving complex problems. This text concisely reviews integration algorithms, then analyzes the widely used Runge-Kutta method. It first presents a complete code before discussin

Partial Differential Equations in Engineering Problems

Springer Science & Business Media
Mathematical models stated as systems of partial differential equations (PDEs) are

broadly used in biology, chemistry, physics and medicine (physiology). These models describe the spatial and temporal variations of the problem system dependent variables, such as temperature, chemical and biochemical concentrations and cell densities, as a function of space and time (spatiotemporal distributions). For a complete PDE model, initial conditions (ICs) specifying how the problem system starts and boundary conditions (BCs) specifying how the system is defined at its spatial boundaries, must also be included for a well-posed PDE model. In this book, PDE models are considered for which the physical boundaries move with time. For example, as a tumor grows, its boundary moves outward. In atherosclerosis, the plaque formation on the arterial wall moves inward, thereby restricting blood flow with serious consequences such as stroke and myocardial infarction (heart attack). These two examples are considered as applications of the reported moving boundary PDE (MBPDE) numerical method (algorithm). The method is programmed in a set of documented routines coded in R, a quality, open-source scientific programming system. The routines are provided as a download so that the reader/analyst/researcher can use MFPDE models without having to first study numerical methods and computer programming.

Partial Differential Equations in Action

Springer Nature

Stochastic Partial Differential Equations analyzes mathematical models of time-dependent physical phenomena on microscopic, macroscopic and mesoscopic levels. It provides a rigorous derivation of each level from the preceding one and examines the resulting mesoscopic equations in detail. Coverage first describes the transition from the microscopic equations to the mesoscopic equations. It then covers a general system for the positions of the large particles.

Differential Equations with Boundary-value Problems

Springer

Time delayed (lagged) variables are an inherent feature of biological/physiological systems. For example, infection from a disease may at first be asymptomatic, and only after a delay is the infection apparent so that treatment can begin. Thus, to adequately describe physiological systems, time delays are frequently required and must be included in the equations of mathematical models. The intent of this book is to present a methodology for the formulation and computer implementation of mathematical models based on time delay ordinary differential equations (DODEs) and partial differential equations (DPDEs). The DODE/DPDE methodology is presented through a series of example applications, particularly in biomedical science and engineering (BMSE). The computer-based implementation of the example models is explained with routines coded (programmed) in R, a quality, open-source scientific computing system that is readily available from the Internet. Formal mathematics is minimized, for example, no theorems and proofs. Rather, the presentation is through detailed examples that the reader/researcher/analyst can execute on modest computers. The DPDE analysis is based on the method of lines (MOL), an established general algorithm for PDEs, implemented with finite differences. The example applications can first be executed to confirm the reported solutions, then extended by variation of the parameters and the equation terms, and even the formulation and use of alternative DODE/DPDE models.

Ordinary Differential Equations World Scientific

This well-acclaimed book, now in its twentieth edition, continues to offer an in-depth presentation of the fundamental concepts and their applications of ordinary and partial differential equations providing systematic solution techniques. The book provides step-by-step proofs of theorems to enhance students' problem-solving skill and includes plenty of carefully chosen solved examples to illustrate the concepts discussed.

Finite Difference Methods for Ordinary and Partial Differential Equations

There are three major changes in the Third Edition of Differential Equations and Their Applications. First, we have completely rewritten the section on singular solutions of differential equations. A new section, 2.8.1, dealing with Euler equations has been added, and this section is used to motivate a greatly expanded treatment of singular equations in sections 2.8.2 and 2.8.3. Our second major change is the addition of a new section, 4.9, dealing with bifurcation theory, a subject of much current interest. We felt it desirable to give the reader a brief but nontrivial introduction to this important topic. Our third major change is in Section 2.6, where we have switched to the metric system of units. This change was requested by many of our readers. In addition to the above changes, we have updated the material on population models, and have revised the exercises in this section. Minor editorial changes have also been made throughout the text.
New York City
November. 1982
Martin Braun Preface to the First Edition This textbook is a unique

blend of the theory of differential equations and their exciting application to "real world" problems. First, and foremost, it is a rigorous study of ordinary differential equations and can be fully understood by anyone who has completed one year of calculus. However, in addition to the traditional applications, it also contains many exciting "real life" problems. These applications are completely self contained.

Stochastic Ordinary and Stochastic Partial Differential Equations Cambridge University Press

This textbook is designed for a one year course covering the fundamentals of partial differential equations, geared towards advanced undergraduates and beginning graduate students in mathematics, science, engineering, and elsewhere. The exposition carefully balances solution techniques, mathematical rigor, and significant applications, all illustrated by numerous examples. Extensive exercise sets appear at the end of almost every subsection, and include straightforward computational problems to develop and reinforce new techniques and results, details on theoretical developments and proofs, challenging projects both computational and conceptual, and supplementary material that motivates the student to delve further into the subject. No previous experience with the subject of partial differential equations or Fourier theory is assumed, the main prerequisites being undergraduate calculus, both one- and multi-variable, ordinary differential equations, and basic linear algebra. While the classical topics of separation of variables, Fourier analysis, boundary value problems, Green's functions, and special functions continue to form the core of an introductory course, the inclusion of nonlinear equations, shock wave dynamics, symmetry and similarity, the Maximum Principle, financial models, dispersion and solutions, Huygens' Principle, quantum mechanical systems, and more make this text well attuned to recent developments and trends in this active field of contemporary research. Numerical approximation schemes are an important component of any introductory course, and the text covers the two most basic approaches: finite differences and finite elements.

Partial Differential Equations World Scientific

This textbook is a unique blend of the theory of differential equations and their exciting application to ··real world" problems. First, and foremost, it is a rigorous study of ordinary differential equations and can be fully understood by anyone who has completed one year of calculus. However, in addition to the traditional applications, it also contains many exciting '·real life" problems. These applications are completely self contained. First, the problem to be solved is outlined clearly, and one or more differential equations are derived as a model for this problem. These equations are then solved, and the results are compared with real world data. The following applications are covered in this text. I. In Section 1.3 we prove that the beautiful painting ··Disciples at Emmaus" which was bought by the Rembrandt Society of Belgium for $170,000 was a modern forgery. 2. In Section 1.5 we derive differential equations which govern the population growth of various species, and compare the results predicted by our models with the known values of the populations. 3. In Section 1.6 we try to determine whether tightly sealed drums filled with concentrated waste material will crack upon impact with the ocean floor. In this section we also describe several tricks for obtaining informa tion about solutions of a differential equation that cannot be solved explicitly.

The Numerical Solution of Ordinary and Partial Differential Equations

Bookboon

This monograph aims to fill a void by making available a source book

which first systematically describes all the available uniqueness and nonuniqueness criteria for ordinary differential equations, and compares and contrasts the merits of these criteria, and second, discusses open problems and offers some directions towards possible solutions.
Differential Equations and Their Applications S. Chand Publishing This unusually well-written, skillfully organized introductory text provides an exhaustive survey of ordinary differential equations — equations which express the relationship between variables and their derivatives. In a disarmingly simple, step-by-step style that never sacrifices mathematical rigor, the authors — Morris Tenenbaum of Cornell University, and Harry Pollard of Purdue University — introduce and explain complex, critically-important concepts to undergraduate students of mathematics, engineering and the sciences. The book begins with a section that examines the origin of differential equations, defines basic terms and outlines the general solution of a differential equation-the solution that actually contains every solution of such an equation. Subsequent sections deal with such subjects as: integrating factors; dilution and accretion problems; the algebra of complex numbers; the

linearization of first order systems; Laplace Transforms; Newton's Interpolation Formulas; and Picard's Method of Successive Approximations. The book contains two exceptional chapters: one on series methods of solving differential equations, the second on numerical methods of solving differential equations. The first includes a discussion of the Legendre Differential Equation, Legendre Functions, Legendre Polynomials, the Bessel Differential Equation, and the Laguerre Differential Equation. Throughout the book, every term is clearly defined and every theorem lucidly and thoroughly analyzed, and there is an admirable balance between the theory of differential equations and their application. An abundance of solved problems and practice exercises enhances the value of Ordinary Differential Equations as a classroom text for undergraduate students and teaching professionals. The book concludes with an in-depth examination of existence and uniqueness theorems about a variety of differential equations, as well as an introduction to the theory of determinants and theorems about Wronskians.

Introduction to Partial Differential Equations Springer Science & Business Media

This revised and updated text, now in its second edition, continues to present the theoretical concepts of methods of solutions of ordinary and partial differential equations. It equips students with the various tools and techniques to model different physical problems using such equations. The book discusses the basic concepts of ordinary and partial differential equations. It contains different methods of solving ordinary differential equations of first order and higher degree. It gives the solution methodology for linear differential equations with constant and variable coefficients and linear differential equations of second order. The text elaborates simultaneous linear differential equations, total differential equations, and partial differential equations along with the series solution of second order linear differential equations. It also covers Bessel's and Legendre's equations and functions, and the Laplace transform. Finally, the book revisits partial differential equations to solve the Laplace equation, wave equation and diffusion equation, and discusses the methods to solve partial differential equations using the Fourier transform. A large number of solved examples as well as exercises at the end of chapters help the students comprehend and strengthen the underlying concepts. The book is intended for undergraduate and postgraduate students of Mathematics (B.A./B.Sc., M.A./M.Sc.), and undergraduate students of all branches of engineering (B.E./B.Tech.), as part of their course in Engineering Mathematics. New to the SECOND Edition • Includes new sections and subsections such as applications of differential equations, special substitution (Lagrange and Riccati), solutions of non-linear equations which are exact, method of variation of parameters for linear equations of order higher than two, and method of undetermined coefficients • Incorporates several worked-out examples and exercises with their answers • Contains a new Chapter 19 on 'Z-Transforms and its Applications'.

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