Decomposition Methods For Differential Equations Theory And Applications Chapman Hallcrc Numerical Analysis And Scientific Computing Series
df245152265d88a89fa7a48257f82f9a


Domain Decomposition Methods for Partial Differential Equations: Theory and Applications describes the analysis of numerical methods for evolution equations based on temporal and spatial decomposition. These methods are particularly well suited for parallel computers. The book describes the method for solving Partial Differential Equations and presents the numerical solution of multi-scale and multi-parameter problems.

Fifth International Symposium on Domain Decomposition Methods for Partial Differential Equations

Domain Decomposition Methods and Harmonic Wave Systems: Partial Differential Equations of the Helmholtz Decomposition

Domain Decomposition Methods in Optimal Control of Partial Differential Equations

Decomposition Methods for Differential Equations: Theory and Applications

Decomposition Methods for Differential Equations and Solitary Waves Theory

Domain Decomposition Methods for Partial Differential Equations

Numerical and Analytical Solutions for Solving Nonlinear Equations in Heat Transfer

Domain Decomposition Methods in Science and Engineering

Domain Decomposition Methods for Solving Partial Differential Equations

Domain Decomposition Methods in Optimal Control of Partial Differential Equations

Proceedings of the Fourth International Colloquium on Numerical Analysis

Domain Decomposition Methods in Science and Engineering

Parallel Numerical AlgorithmsProceedings of the Fourth International Colloquium on Numerical Analysis


Parallel Numerical AlgorithmsProceedings of the Fourth International Colloquium on Numerical Equations

The book presents an elegant discussion of domain decomposition algorithms, their implementation and analysis. Ideal for graduate students about to embark on a career in computational science. It will also be a valuable resource for all those interested in parallel and numerical computational methods.

Nonlinear differential equations are ubiquitous in computational science and engineering modeling, fluid dynamics, finance, and quantum mechanics, among other areas. Nowadays, solving challenging problems in an industrial setting requires a continuous interplay between the theory of such systems and the development and use of sophisticated computational methods that can guide and support the theoretical findings via practical computer simulations. Owing to the impressive development in computer technology and the introduction of fast numerical methods with reduced algorithmic and memory complexity, rigorous solutions in many applications have become possible.

The book collects research papers from leading world experts in the field, highlighting ongoing trends, progress, and open problems in this critically important area of mathematical science.

Focusing on the notion that by breaking the domain of the original problem into subdomains, such an approach can, if properly implemented, lead to a considerable speedup.

The methods are particularly well suited for parallel computers.

The book is devoted to recent developments in the theory of fractional calculus and its applications. Particular attention is paid to the applicability of this currently popular research field in various branches of pure and applied mathematics. In particular, the book focuses on the more recent results in mathematical physics, engineering applications, theoretical and applied physics as quantum mechanics, signal analysis, and in those relevant research fields where nonlinear dynamics occurs and several tools of nonlinear analysis are required. Dynamical processes and dynamical systems of fractional order attract researchers from many areas of sciences and technologies, ranging from mathematics and physics to computer science.

Domain decomposition methods are divide and conquer computational methods for the parallel solution of partial differential equations of elliptic or parabolic type. The methodology includes iterative algorithms, and techniques for non-matching grid discretizations and heterogeneous approximations. This book serves as a matrix oriented introduction to domain decomposition methodology. A wide range of topics are discussed include hybrid formulations, Schwarz, and many more.

While domain decomposition methods have a long history dating back well over one hundred years, it is only during the last decade that they have become a major tool in numerical research. The differential equations this book graph emphasizes in the context of so-called virtual optimal control problems, and it treats optimal control problems for partial differential equations and their decompositions using an all-at-once approach.

The Fifth International Colloquium on Differential Equations was organized by UNESCO and the Plovdiv Technical University, with the help of many international mathematical organizations, and was held in Plovdiv, Bulgaria, 18–23 August 1993. This proceedings volume contains selected invited talks which deal with the following topics: - impulsive differential equations -- nonlinear differential equations -- differential equations with maxima -- applications of differential equations

Engineering applications offer opportunities and challenges across a range of different industries and fields. By developing effective methods of analysis, results and solutions are produced with higher accuracy. Numerical and Analytical Solutions for Solving Nonlinear Equations in Heat Transfer is an innovative source of academic research on the optimization of domains in analyzing heat transfer equations and the application of these methods across various fields. Highlighting pertinent topics such as the differential transformation method, industrial applications, and the homotopy perturbation method, this book is ideally designed for engineers, researchers, graduate students, professionals, and academics interested in applying new mathematical techniques in engineering sciences.

This book offers a comprehensive presentation of some of the most successful and popular domain decomposition preconditioners for finite and spectral element approximations of partial differential equations. It places strong emphasis on both algorithmic and mathematical aspects. It covers in detail important methods such as FETI and balancing Neumann-Neumann methods and algorithms for spectral element methods.

This book presents the first survey of the Localized Orthogonal Decomposition (LOD) method, a pioneering approach for the numerical homogenization of partial differential equations with multiscale data beyond periodicity and scale separation. The authors provide a careful error analysis, including previously unpublished results, and a complete implementation of the method in MATLAB. They also reveal how the LOD method relates to classical homogenization and domain decomposition. Illustrated with numerical experiments that demonstrate the significance of the method, the book is enhanced by a survey of applications including eigenvalue problems and evolution problems.

Numerical Homogenization by Localized Orthogonal Decomposition is appropriate for graduate students in applied mathematics, numerical analysis, and scientific computing. Researchers in the field of computational partial differential equations will find this self-contained book of interest, as will applied scientists and engineers interested in multiscale simulation.

The Adomian decomposition method enables the accurate and efficient analytic solution of nonlinear ordinary or partial differential equations without the need to resort to linearization or perturbation approaches. It unifies the treatment of linear and nonlinear, ordinary or partial differential equations, or systems of such equations, into a single basic approach to both initial and boundary value problems. The method is particularly well suited for the solution of nonlinear differential equations that have previously required much more computationally-intensive approaches. The opening chapters deal with some frontier problems which have previously required much more computationally-intensive approaches.

Decomposition Methods for Evolution Equations: Theory and Applications describes the analysis of numerical methods for evolution equations based on temporal and spatial
Computing Series
Read Online Decomposition Methods For Differential Equations Theory And Applications Chapman Hall/CRC Mathematical Analysis And Scientific Computing Methods

Stochastic Systems
In this text, we introduce the basic concepts for the numerical modelling of partial differential equations. We consider the classical elliptic, parabolic and hyperbolic linear equations, but also the diffusion, transport, and Navier-Stokes equations, as well as equations representing conservation laws, saddle-point problems and optimal control problems. Furthermore, we provide numerous physical examples which underline such equations. We then analyze numerical solution methods based on finite elements, finite differences and integral methods and discuss algorithms, implementation aspects and provide a number of easy-to-use programs. The text does not require any previous advanced mathematical knowledge of partial differential equations: the absolutely essential concepts are reported in a preliminary chapter. It is therefore suitable for students of bachelor and master courses in scientific disciplines, and recommendable to those researchers in the academic and extra-academic domain who want to approach this interesting branch of applied mathematics.

“Partial Differential Equations and Solitary Waves Theory” is a self-contained book divided into two parts: Part I is a coherent survey bringing together newly developed methods for solving PDEs. While some traditional techniques are presented, this part does not require thorough understanding of abstract theories or compact concepts. Well-selected worked examples and exercises shall guide the reader through the text. Part II provides an extensive exposition of the solitary waves theory. This part handles nonlinear evolution equations by methods such as homotopy analysis, variational iteration, and homotopy perturbation. A self-contained method is presented to compute the uncertainty of a wide class of nonlinear equations. This part presents in an accessible manner a systematic presentation of solitons, multi-soliton solutions, kinks, peaks, cuspons, and compactons. While the whole book can be used as a text for advanced undergraduate and graduate students in applied mathematics, physics and engineering, Part II will be more suited for researchers and specialists.

Diffusion equation is the main research area concerned with the development, analysis, and implementation of coupling and decoupling strategies in mathematical and computational models of natural and engineered systems. The present system sets forth new contributions in areas of numerical analysis, computer science, scientific and industrial applications, and software development.

A Powerful Methodology for Solving All Types of Differential Equations Decomposition Analysis Method in Linear and Non-Linear Differential Equations explains how the Adomian decomposition method can solve differential equations for the series solutions of fundamental problems in physics, astrophysics, chemistry, biology, medicine, and other relevant fields. It is a powerful method for solving a wide range of problems. The book covers a broad range of topics, including linear and non-linear differential equations, and provides a new approach for solving partial differential equations. It then looks at Laplace, Fourier, and weighted residual methods for solving differential equations. A new challenging method of Boundary Characteristics Orthogonal Polynomials (BCOPs) is introduced next. The book then discusses Finite Difference Method (FDM), Finite Element Method (FEM), Finite Volume Method (FVM), and Boundary Element Method (BEM). Following that, analytical/semi analytic methods like Akbari Ganji’s Method (AGM) and Exp-function are used to solve nonlinear differential equations. Nonlinear differential equations using semi-analytical methods are also addressed, namely Adomian Decomposition Method (ADM), Homotopy Perturbation Method (HPM), Variational Iteration Method (VIM), and Homotopy Analysis Method (HAM). Other topics covered include: emerging areas of research related to the solution of differential equations based on fluids between plates and through tubes, the flow of blood through arteries, and the flow past a wide-shape wall, demonstrate the applications. Drawing on the author’s extensive research in fluid and gas dynamics, this book shows how the powerful decomposition methodology of Adomian can solve differential equations in a way comparable to any contemporary superfast computer.

Examine numerical and semi-analytical methods for differential equations that can be used for solving practical ODEs and PDEs. This student-friendly book deals with various approaches for solving differential equations numerically or semi-analytically depending on the type of equations and offers simple example problems to help readers along. Features include:

- Finite differences methods. The book covers both explicit and implicit methods with a review and examples.
- A discussion of the operators for each method.
- A new approach for solving partial differential equations.
- A new challenging method of Boundary Characteristics Orthogonal Polynomials (BCOPs) is introduced.

The book then discusses Finite Difference Method (FDM), Finite Element Method (FEM), Finite Volume Method (FVM), and Boundary Element Method (BEM). Following that, analytical/semi analytic methods like Akbari Ganji’s Method (AGM) and Exp-function are used to solve nonlinear differential equations. Nonlinear differential equations using semi-analytical methods are also addressed, namely Adomian Decomposition Method (ADM), Homotopy Perturbation Method (HPM), Variational Iteration Method (VIM), and Homotopy Analysis Method (HAM). Other topics covered include: emerging areas of research related to the solution of differential equations based on fluids between plates and through tubes, the flow of blood through arteries, and the flow past a wide-shape wall, demonstrate the applications. Drawing on the author’s extensive research in fluid and gas dynamics, this book shows how the powerful decomposition methodology of Adomian can solve differential equations in a way comparable to any contemporary superfast computer.

The purpose of this book is to offer an overview of the most popular decomposition methods for partial differential equations (PDEs). These methods are widely used for numerical simulations in solid mechanics, electromagnetism, flow in porous media, etc., on parallel machines from tens to hundreds of thousands of cores. The appealing feature of domain decomposition methods is that, contrary to direct methods, they are naturally parallel. The authors focus on parallel linear solvers. The authors present all parallel linear solvers at the same level in terms of their implementation aspects and provide a number of easy-to-use programs. The text does not require any previous advanced mathematical knowledge of partial differential equations. Furthermore, we provide numerous physical examples which underline such equations. We then analyze numerical solution methods based on finite elements, finite differences and integral methods and discuss algorithms, implementation aspects and provide a number of easy-to-use programs. The text does not require any previous advanced mathematical knowledge of partial differential equations: the absolutely essential concepts are reported in a preliminary chapter. It is therefore suitable for students of bachelor and master courses in scientific disciplines, and recommendable to those researchers in the academic and extra-academic domain who want to approach this interesting branch of applied mathematics.

Harmonic Waves is the first textbook for the computational method of Decomposition in Invariant Structures (DIS) that generalizes the analytical methods of separation of variables, undetermined coefficients, asymptotic expansions, and series expansions. In recent years, there has been a boom in publications on propagation of nonlinear waves described by a fascinating list of partial differential equations (PDEs). The vast majority of wave problems are reducible to one-dimensional ones in propagation variables. Here is a list of publications with two- and three-dimensional applications of the DIS method is brief. The book offers a comprehensive and rigorous treatment of the DIS method in one and two dimensions. Some basic principles are extended in the text. All applications of the DIS are motivated by the need for new methods that are scalable and compact. The book discusses the DIS method for partial differential equations (PDEs) and discusses the similarities and differences with other methods such as finite elements and finite differences. A unified view of soliton theory for ODEs and PDEs is presented, and the interplay between ODE and PDE analysis is stressed. The text emphasizes standard classical methods, but several newer approaches are also introduced and are described in the context of simple motivating examples.

Papers presented at the May 1991 symposium reflect continuing interest in the role of domain decomposition in the effective utilization of parallel systems; applications in fluid mechanics, structures, biology, and design optimization; and maturation of analysis of elliptic equations, with theoretic

Domain decomposition is an active, interdisciplinary research area that is devoted to the development, analysis and implementation of coupling and decoupling strategies in mathematics, computational science, engineering and industry. A series of international conferences starting in 1987 set the stage for the presentation of many meanwhile classical results on substructuring, block iterative methods, parallel and distributed high performance computing etc. This volume contains a selection from the papers presented at the 15th International Domain Decomposition Conference held in Berlin, Germany, July 17-25, 2003 by the world’s leading experts in the field. Its special focus has
Nonlinear Stochastic Operator Equations deals with realistic solutions of the nonlinear stochastic equations arising from the modeling of frontier problems in many fields of science. This book also discusses a wide class of equations to provide modeling of problems concerning physics, engineering, operations research, systems analysis, biology, medicine. This text discusses operator equations and the decomposition method. This book also explains the limitations, restrictions and assumptions made in differential equations involving stochastic process coefficients (the stochastic operator case), which yield results very different from the needs of the actual physical problem. Real-world application of mathematics to actual physical problems, requires making a reasonable model that is both realistic and solvable. The decomposition approach or model is an approximation method to solve a wide range of problems. This book explains an inherent feature of real systems—known as nonlinear behavior—that occurs frequently in nuclear reactors, in physiological systems, or in cellular growth. This text also discusses stochastic operator equations with linear boundary conditions. This book is intended for students with a mathematics background, particularly senior undergraduate and graduate students of advanced mathematics, of the physical or engineering sciences.

Proper Orthogonal Decomposition Methods for Partial Differential Equations evaluates the potential applications of POD reduced-order numerical methods in increasing computational efficiency, decreasing calculating load and alleviating the accumulation of truncation error in the computational process. Introduces the foundations of finite-differences, finite-elements and finite-volume-elements. Models of time-dependent PDEs are presented, with detailed numerical procedures, implementation and error analysis. Output numerical data are plotted in graphics and compared using standard traditional methods. These models contain parabolic, hyperbolic and nonlinear systems of PDEs, suitable for the user to learn and adapt methods to their own R&D problems. Explains ways to reduce order for PDEs by means of the POD method so that reduced-order models have few unknowns Helps readers speed up computation and reduce computation load and memory requirements while numerically capturing system characteristics Enables readers to apply and adapt the methods to solve similar problems for PDEs of hyperbolic, parabolic and nonlinear types

This book discusses various novel analytical and numerical methods for solving partial and fractional differential equations. Moreover, it presents selected numerical methods for solving stochastic point kinetic equations in nuclear reactor dynamics by using Euler–Maruyama and strong-order Taylor numerical methods. The book also shows how to arrive at new, exact solutions to various fractional differential equations, such as the time-fractional Burgers–Hopf equation, the (3+1)-dimensional time-fractional Khokhlov–Zabolotskaya–Kuznetsov equation, (3+1)-dimensional time-fractional KdV–Khokhlov–Zabolotskaya–Kuznetsov equation, fractional (2+1)-dimensional Davey–Stewartson equation, and integrable Davey–Stewartson-type equation. Many of the methods discussed are analytical–numerical, namely the modified decomposition method, a new two-step Adomian decomposition method, new approach to the Adomian decomposition method, modified homotopy analysis method with Fourier transform, modified fractional reduced differential transform method (CFRDTM), optimal homotopy asymptotic method, first integral method, and a solution procedure based on Haar wavelets and the operational matrices with function approximation. The book proposes for the first time a generalized order operational matrix of Haar wavelets, as well as new techniques (MFRDTM and CFRDTM) for solving fractional differential equations. Numerical methods used to solve stochastic point kinetic equations, like the Wiener process, Euler–Maruyama, and order 1.5 strong Taylor methods, are also discussed.

Through this volume a selection of 41 refereed papers presented at the 18th International Conference of Domain Decomposition Methods hosted by the School of ComputerScience and Engineering(CSE) of the Hebrew University of Jerusalem, Israel, January 12–17, 2008. 1 Background of the Conference Series The International Conference on Domain Decomposition Methods has been held in twelve countries throughout Asia, Europe, the Middle East, and North America, beginning in Paris in 1987. Originally held annually, it is now spaced at roughly 18-month intervals. A complete list of past meetings appears below. The principal technical content of the conference has always been mathematical, but the principal motivation has been to make efficient use of distributed memory computers for complex applications arising in science and engineering. The leading 15 such computers, at the “petascale” characterized by 100,000 point operations per second of processing power and as many Bytes of application-addressable memory, now marshal more than 200,000 independent processor cores, and systems with many millions of cores are expected soon. There is essentially no alternative to - main decomposition as a strategy for parallelization at such scales. Contributions from mathematicians, computer scientists, engineers, and scientists are together n- essay in addressing the challenge of scale, and all are important to this conference.

A domain decomposition method for solving partial differential equations is described. The conditions on interfaces will all be of Dirichlet type and obtained by the boundary element method using very few (less than 10) unknowns. (KR).