Sinc Methods For Domain Decomposition

#sinc methods #domain decomposition #numerical analysis #partial differential equations #high accuracy computational methods

Explore the application of Sinc Methods within Domain Decomposition strategies, offering highly accurate and efficient approaches for solving complex problems. This technique is crucial in numerical analysis for partitioning computational domains, especially in contexts involving partial differential equations, leading to high-accuracy computational methods.

Domain Decomposition Methods in Science and Engineering

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 been on numerical analysis, computational issues,complex heterogeneous problems, industrial problems, and software development.

Domain Decomposition Methods in Scientific and Engineering Computing

This book contains proceedings from the Seventh International Conference on Domain Decomposition Methods, held at Pennsylvania State University in October 1993. The term ``domain decomposition'' has for nearly a decade been associated with the partly iterative, partly direct algorithms explored in the proceedings of this conference. Noteworthy trends in the current volume include progress in dealing with so-called ``bad parameters'' in elliptic partial differential equation problems, as well as developments in partial differential equations outside of the elliptically-dominated framework. Also described here are convergence and complexity results for novel discretizations, which bring with them new challenges in the derivation of appropriate operators for coarsened spaces. Implementations and architectural considerations are discussed, as well as partitioning tools and environments. In addition, the book describes a wide array of applications, from semiconductor device simulation to structural mechanics to aerodynamics. Presenting many of the latest results in the field, this book offers readers an up-to-date guide to the many facets of the theory and practice of domain decomposition.

Domain Decomposition Methods in Science and Engineering XVIII

th This volume contains a selection of 41 refereed papers presented at the 18 International Conference of Domain Decomposition Methods hosted by the School of ComputerScience and Engineering(CSE) of the Hebrew Universityof 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 ef cient use of distributed memory computers for complex applications arising in science and engineering. The leading 15 such computers, at the “petascale” characterized by 10 oating point operations per second of processing power and as many Bytes of application-addressablem- ory, now marshal more than 200,000 independentprocessor cores, and systems with many millions of cores are expected soon. There is essentially no alternative to - main decomposition as a stratagem for parallelization at such scales. Contributions from mathematicians, computerscientists, engineers,and scientists are together n- essary in addressing the challenge of scale, and all are important to this conference.

Computation and Control IV

Proceedings of a conference of leading experts in control theory, numerical mathematics and various application areas. The conference’s interdisciplinary dialogue not only creates new mathematical tools, it often produces new research problems in the individual disciplines, aiming to develop rigorous numerical methods and computational tools for control design and analysis.

Handbook of Sinc Numerical Methods

Handbook of Sinc Numerical Methods presents an ideal road map for handling general numeric problems. Reflecting the author's advances with Sinc since 1995, the text most notably provides a detailed exposition of the Sinc separation of variables method for numerically solving the full range of partial differential equations (PDEs) of interest to sci

New Sinc Methods of Numerical Analysis

This contributed volume honors the 80th birthday of Frank Stenger who established new Sinc methods in numerical analysis.The contributions, written independently from each other, show the new developments in numerical analysis in connection with Sinc methods and approximations of solutions for differential equations, boundary value problems, integral equations, integrals, linear transforms, eigenvalue problems, polynomial approximations, computations on polyhedra, and many applications. The approximation methods are exponentially converging compared with standard methods and save resources in computation. They are applicable in many fields of science including mathematics, physics, and engineering.The ideas discussed serve as a starting point in many different directions in numerical analysis research and applications which will lead to new and unprecedented results. This book will appeal to a wide readership, from students to specialized experts.

Domain Decomposition Methods

Many mathematicians, scientists, and engineers are familiar with the Fast Fourier Transform, a method based upon the Discrete Fourier Transform. Perhaps not so many mathematicians, scientists, and engineers recognize that the Discrete Fourier Transform is one of a family of symbolic formulae called Sinc methods. Sinc methods are based upon the Sinc function, a wavelet-like function replete with identities which yield approximations to all classes of computational problems. Such problems include problems over finite, semi-infinite, or infinite domains, problems with singularities, and boundary layer problems. Written by the principle authority on the subject, this book introduces Sinc methods to the world of computation. It serves as an excellent research sourcebook as well as a textbook which uses analytic functions to derive Sinc methods for the advanced numerical analysis and applied approximation theory classrooms. Problem sections and historical notes are included.

Numerical Methods Based on Sinc and Analytic Functions

This book contains the proceedings of the Special Session, Interaction of Inverse Problems and Image Analysis, held at the January 2001 meeting of the AMS in New Orleans, LA. The common thread among inverse problems, signal analysis, and image analysis is a canonical problem: recovering an

object (function, signal, picture) from partial or indirect information about the object. Both inverse problems and imaging science have emerged in recent years as interdisciplinary research fields with profound applications in many areas of science, engineering, technology, and medicine. Research in inverse problems and image processing shows rich interaction with several areas of mathematics and strong links to signal processing, variational problems, applied harmonic analysis, and computational mathematics. This volume contains carefully referred and edited original research papers and high-level survey papers that provide overview and perspective on the interaction of inverse problems, image analysis, and medical imaging. The book is suitable for graduate students and researchers interested in signal and image processing and medical imaging.

Inverse Problems, Image Analysis, and Medical Imaging

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Domain Decomposition Methods in Science and Engineering

These are the proceedings of the 26th International Conference on Domain Decomposition Methods in Science and Engineering, which was hosted by the Chinese University of Hong Kong and held online in December 2020. Domain decomposition methods are iterative methods for solving the often very large systems of equations that arise when engineering problems are discretized, frequently using finite elements or other modern techniques. These methods are specifically designed to make effective use of massively parallel, high-performance computing systems. The book presents both theoretical and computational advances in this domain, reflecting the state of art in 2020.

Domain Decomposition Methods in Science and Engineering XXVI

This book constitutes the refereed proceedings of the 11th International Workshop on Computer Algebra in Scientific Computing, CASC 2009, held in Kobe, Japan, in September 2009. The 28 revised full papers presented together with 2 invited lectures were carefully reviewed and selected from numerous submissions. The topics addressed are all basic areas of scientific computing as they benefit from the application of computer algebra methods and software. The papers cover computer algebra methods and algorithms, application of symbolic and algebraic manipulation, and CA methods and results for the numerical integration of the partial differential equations of the mathematical physics.

Computer Algebra in Scientific Computing

This book offers a comprehensive collection of the most advanced numerical techniques for the efficient and effective solution of simulation and optimization problems governed by systems of time-dependent differential equations. The contributions present various approaches to time domain decomposition, focusing on multiple shooting and parareal algorithms. The range of topics covers theoretical analysis of the methods, as well as their algorithmic formulation and guidelines for practical implementation. Selected examples show that the discussed approaches are mandatory for the solution of challenging practical problems. The practicability and efficiency of the presented methods is illustrated by several case studies from fluid dynamics, data compression, image processing and computational biology, giving rise to possible new research topics. This volume, resulting from the workshop Multiple Shooting and Time Domain Decomposition Methods, held in Heidelberg in May 2013, will be of great interest to applied mathematicians, computer scientists and all scientists using mathematical methods.

Multiple Shooting and Time Domain Decomposition Methods

Completely revised text focuses on use of spectral methods to solve boundary value, eigenvalue, and time-dependent problems, but also covers Hermite, Laguerre, rational Chebyshev, sinc, and spherical harmonic functions, as well as cardinal functions, linear eigenvalue problems, matrix-solving methods,

coordinate transformations, methods for unbounded intervals, spherical and cylindrical geometry, and much more. 7 Appendices. Glossary. Bibliography. Index. Over 160 text figures.

Chebyshev and Fourier Spectral Methods

This book is a collection of papers presented at the 23rd International Conference on Domain Decomposition Methods in Science and Engineering, held on Jeju Island, Korea on July 6-10, 2015. Domain decomposition methods solve boundary value problems by splitting them into smaller boundary value problems on subdomains and iterating to coordinate the solution between adjacent subdomains. Domain decomposition methods have considerable potential for a parallelization of the finite element methods, and serve a basis for distributed, parallel computations.

Domain Decomposition: a Bridge Between Nature and Parallel Computers

These are the proceedings of the 19th international conference on domain decomposition methods in science and engineering. Domain decomposition methods are iterative methods for solving the often very large linear or nonlinear systems of algebraic equations that arise in various problems in mathematics, computational science, engineering and industry. They are designed for massively parallel computers and take the memory hierarchy of such systems into account. This is essential for approaching peak floating point performance. There is an increasingly well-developed theory which is having a direct impact on the development and improvement of these algorithms.

Domain Decomposition Methods in Science and Engineering XXIII

In this book the author sets out to answer two important questions: 1. Which numerical methods may be combined together? 2. How can different numerical methods be matched together? In doing so the author presents a number of useful combinations, for instance, the combination of various FEMs, the combinations of FEM-FDM, REM-FEM, RGM-FDM, etc. The combined methods have many advantages over single methods: high accuracy of solutions, less CPU time, less computer storage, easy coupling with singularities as well as the complicated boundary conditions. Since coupling techniques are essential to combinations, various matching strategies among different methods are carefully discussed. The author provides the matching rules so that optimal convergence, even superconvergence, and optimal stability can be achieved, and also warns of the matching pitfalls to avoid. Audience: The book is intended for both mathematicians and engineers and may be used as text for advanced students.

Domain Decomposition Methods in Science and Engineering XXI

Mathematics of Computing -- Numerical Analysis.

Mathematical Reviews

Toeplitz and Toeplitz-related systems arise in a variety of applications in mathematics and engineering, especially in signal and image processing.

Domain Decomposition Methods in Science and Engineering XIX

This volume contains the proceedings of the 4th International Conference on Numerical Methods and Applications. The major topics covered include: general finite difference, finite volume, finite element and boundary element methods, general numerical linear algebra and parallel computations, numerical methods for nonlinear problems and multiscale methods, multigrid and domain decomposition methods, CFD computations, mathematical modeling in structural mechanics, and environmental and engineering applications. The volume reflects the current research trends in the specified areas of numerical methods and their applications.

Combined Methods for Elliptic Equations with Singularities, Interfaces and Infinities

This title was reviewed in the January 2009 issue of Mathematical Reviews.

Spectral Methods in MATLAB

This book covers new and significant research related to the mathematical modelling of engineering and environmental processes, manufacturing, and industrial systems. It includes heat transfer, fluid

mechanics, CFD, and transport phenomena; solid mechanics and mechanics of metals; electromagnets and MHD; reliability modelling and system optimisation; finite volume, finite element, and boundary element procedures; decision sciences in an industrial and manufacturing context; civil engineering systems and structures; mineral and energy resources; relevant software engineering issues associated with CAD and CAE; and materials and metallurgical engineering.

Dissertation Abstracts International

The three most important nonoverlapping domain-decomposition methods are outlined in this guide to solving mechanical and transport problems. Each method is described with extensive details of the implementation of algorithms and is applied to real engineering examples. Intended for researchers and postgraduate students, this advanced material covers the Schur complement, the FETI, and the DP-FETI decomposition models, and it shows how to run them on clusters of PCs and other parallel computers.

Domain Decomposition Algorithms for First-order System Least Squares Methods

Tearing and interconnecting methods, such as FETI, FETI-DP, BETI, etc., are among the most successful domain decomposition solvers for partial differential equations. The purpose of this book is to give a detailed and self-contained presentation of these methods, including the corresponding algorithms as well as a rigorous convergence theory. In particular, two issues are addressed that have not been covered in any monograph yet: the coupling of finite and boundary elements within the tearing and interconnecting framework including exterior problems, and the case of highly varying (multiscale) coefficients not resolved by the subdomain partitioning. In this context, the book offers a detailed view to an active and up-to-date area of research.

Convergence Analysis of Domain Decomposition Algorithms with Full Overlapping for the Advection-diffusion Problems

This book explains how, when and why the pseudospectral approach works.

Iterative Methods for Toeplitz Systems

This book summarizes the basic theory of wavelets and some related algorithms in an easy-to-understand language from the perspective of an engineer rather than a mathematician. In this book, the wavelet solution schemes are systematically established and introduced for solving general linear and nonlinear initial boundary value problems in engineering, including the technique of boundary extension in approximating interval-bounded functions, the calculation method for various connection coefficients, the single-point Gaussian integration method in calculating the coefficients of wavelet expansions and unique treatments on nonlinear terms in differential equations. At the same time, this book is supplemented by a large number of numerical examples to specifically explain procedures and characteristics of the method, as well as detailed treatments for specific problems. Different from most of the current monographs focusing on the basic theory of wavelets, it focuses on the use of wavelet-based numerical methods developed by the author over the years. Even for the necessary basic theory of wavelet in engineering applications, this book is based on the author’s own understanding in plain language, instead of a relatively difficult professional mathematical description. This book is very suitable for students, researchers and technical personnel who only want to need the minimal knowledge of wavelet method to solve specific problems in engineering.

Recent Advances In Numerical Methods And Applications Ii - Proceedings Of The Fourth International Conference

This self-contained monograph presents matrix algorithms and their analysis. The new technique enables not only the solution of linear systems but also the approximation of matrix functions, e.g., the matrix exponential. Other applications include the solution of matrix equations, e.g., the Lyapunov or Riccati equation. The required mathematical background can be found in the appendix. The numerical treatment of fully populated large-scale matrices is usually rather costly. However, the technique of hierarchical matrices makes it possible to store matrices and to perform matrix operations approximately with almost linear cost and a controllable degree of approximation error. For important classes of matrices, the computational cost increases only logarithmically with the approximation error. The operations provided include the matrix inversion and LU decomposition. Since large-scale linear

algebra problems are standard in scientific computing, the subject of hierarchical matrices is of interest to scientists in computational mathematics, physics, chemistry and engineering.

Trefftz and Collocation Methods

Here is an elementary development of the Sinc-Galerkin method with the focal point being ordinary and partial differential equations. This is the first book to explain this powerful computational method for treating differential equations. These methods are an alternative to finite difference and finite element schemes, and are especially adaptable to problems with singular solutions. The text is written to facilitate easy implementation of the theory into operating numerical code. The authors' use of differential equations as a backdrop for the presentation of the material allows them to present a number of the applications of the sinc method. Many of these applications are useful in numerical processes of interest quite independent of differential equations. Specifically, numerical interpolation and quadrature, while fundamental to the Galerkin development, are useful in their own right. The intimate connection between collocation and Galerkin for the sinc basis is exposed via sinc-interpolation. The quadrature rules define a class of numerical integration methods that complement better known techniques, which in the case of singular integrands, often require modification. The sinc methodology of the text is illustrated on such applications as initial data recovery, heat diffusion, advective-diffusive transport, and Burgers' equation, to illustrate the numerical implementation of the theory discussed. Engineers may find sinc methods a very competitive approach to the more common boundary element or finite element methods. Further, workers in the signal processing community may find this particular approach a refreshingly different view of the use of sinc functions. Sinc approximation is a relatively new numerical technique. This book provides a much needed elementary level explanation. It has been used for graduate numerical classes at Montana State University and Texas Tech University.

Domain Decomposition Methods in Sciences and Engineering

Leading-edge Applied Mathematical Modeling Research