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Fluid Flow And Heat Transfer Applications
Parallel and Distributed Processing and Applications
Inside Finite Elements
Image-Based Geometric Modeling and Mesh Generation
Meshfree Methods for Partial Differential Equations VII
Advanced Modelling with the MATLAB Reservoir Simulation Toolbox
TRIFEM 1
Adaptive High-order Methods in Computational Fluid Dynamics
Basic Concepts and Applications
Computational Electromagnetics with MATLAB, Fourth Edition
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27th International Meshing Roundtable
Proceedings of the 17th International Meshing Roundtable
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Numerical Techniques in Electromagnetics, Second Edition
Delaunay Mesh Generation
The Finite Element Method: Its Basis and Fundamentals
Handbook of Grid Generation
Computing in Euclidean Geometry
Modeling, Mesh Generation, and Adaptive Numerical Methods for Partial Differential Equations
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Fluid Flow And Heat Transfer Applications CRC Press
An informative look at the theory, computer implementation, and application of the scaled boundary finite element method This reliable resource, complete with MATLAB, is an easy-to-understand introduction to the fundamental principles of the scaled boundary finite element method. It establishes the theory of the scaled boundary finite element method systematically as a general numerical procedure, providing the reader with a sound knowledge to expand the applications of this method to a broader scope. The book also presents the applications of the scaled boundary finite element to illustrate its salient features and potentials. The Scaled Boundary Finite Element Method: Introduction to Theory and Implementation covers the static and dynamic stress analysis of solids in two and three dimensions. The relevant concepts, theory and modelling issues of the scaled boundary finite element method are discussed and the unique features of the method are highlighted. The applications in computational fracture mechanics are detailed with numerical examples. A unified mesh generation procedure based on quadtree/octree algorithm is described. It also presents examples of fully automatic stress analysis of geometric models in NURBS, STL and digital images. Written in lucid and easy to understand language by the co-inventor of the scaled boundary element method Provides MATLAB as an integral part of the book with the code cross-referenced in the text and the use of the code illustrated by examples Presents new developments in the scaled boundary finite element method with illustrative examples so that readers can appreciate the significant features and potentials of this novel method—especially in emerging technologies such as 3D printing, virtual reality, and digital image-based analysis The Scaled Boundary Finite Element Method: Introduction to Theory and Implementation is an ideal book for researchers, software developers, numerical analysts, and postgraduate students in many fields of engineering and science.
Parallel and Distributed Processing and Applications Cambridge University Press
This volume contains the articles presented at the 17th International Meshing Roundtable (IMR) organized, in part, by Sandia National Laboratories and held October 12-15, 2008. The volume presents recent results of mesh generation and adaptation which has applications to finite element simulation. It introduces theoretical and novel ideas with practical potential.
Inside Finite Elements Springer
Presents advanced reservoir simulation methods used in the widely-used MRST open-source software for researchers, professionals, students.
Image-Based Geometric Modeling and Mesh Generation World Scientific
The International Meshing Roundtable (IMR) brings together researchers, developers, and application experts in a variety of disciplines, from all over the world, to present and discuss ideas on mesh generation and related topics. The technical papers in this volume present theoretical and novel ideas and algorithms with practical potential, as well as technical applications in science and engineering, geometric modelling, computer graphics, and visualization.
Meshfree Methods for Partial Differential Equations VII Springer Science & Business Media
This book consists of important contributions by world-renowned experts on adaptive high-order methods in computational fluid dynamics (CFD). It covers several widely used, and still intensively researched methods, including the discontinuous Galerkin, residual distribution, finite volume, differential quadrature, spectral volume, spectral difference, PNPM, and correction procedure via reconstruction methods. The main focus is applications in aerospace engineering, but the book should also be useful in many other engineering disciplines including mechanical, chemical and electrical engineering. Since many of these methods are still evolving, the book will be an excellent reference for researchers and graduate students to gain an understanding of the state of the art and remaining challenges in high-order CFD methods.
Advanced Modelling with the MATLAB Reservoir Simulation Toolbox Momentum Press
This text on numerical methods applied to the analysis of electromagnetic nondestructive testing (NOT) phenomena is the first in a series devoted to all aspects of engineering nondestructive evaluation. The timing of this series is most appropriate as many university engineering/physics faculties around the world, recognizing the industrial significance of the subject, are organizing new courses and programs with engineering NOE as a theme. Additional texts in the series will cover electromagnetics for engineering NOE, microwave NOT methods, ultrasonic testing, radiographic methods and signal processing for NOE. It is the intended purpose of the series to provide senior-graduate level coverage of the material suitable for university curricula and to be generally useful to those in industry with engineering degrees who wish to upgrade their NOE skills beyond those needed for certification. This dual purpose for the series reflects the very applied nature of NOE and the need to develop suitable texts capable of bridging the gap between research laboratory studies of NOE phenomena and the real world of certification and industrial applications. The reader might be tempted to question these assertions in light of the rather mathematical nature of this first text. However, the subject of numerical modeling is of critical importance to a thorough understanding of the field-defect interactions at the heart of all electromagnetic NOT phenomena.
TRIFEM 1 Elsevier
This report describes the various mesh tools that are provided with the PROTEUS code giving both descriptions of the input and output. In many cases the examples are provided with a regression test of the mesh tools. The most important mesh tools for any user to consider using are the MT_MeshToMesh.x and the MT_RadialLattice.x codes. The former allows the conversion between most mesh types handled by PROTEUS while the second allows the merging of multiple (assembly) meshes into a radial structured grid. Note that the mesh generation process is recursive in nature and that each input specific for a given mesh tool (such as .axial or .merge) can be used as "mesh" input for any of the mesh tools discussed in this manual.
Adaptive High-order Methods in Computational Fluid Dynamics Springer
This book is a collection of selected papers presented at the last Scientific Computing in Electrical Engineering (SCEE) Conference, held in Sinaia, Romania, in 2006. The series of SCEE conferences

aims at addressing mathematical problems which have a relevance to industry, with an emphasis on modeling and numerical simulation of electronic circuits, electromagnetic fields but also coupled problems and general mathematical and computational methods.
Basic Concepts and Applications CRC Press
Triangle-mesh modeling, as one of the approaches for representing images based on nonuniform sampling, has become quite popular and beneficial in many applications. In this thesis, image representation using triangle-mesh models and its application in image scaling are studied. Consequently, two new methods, namely, the SEMMG and MIS methods are proposed, where each solves a different problem. In particular, the SEMMG method is proposed to address the problem of image representation by producing effective mesh models that are used for representing grayscale images, by minimizing squared error. The MIS method is proposed to address the image-scaling problem for grayscale images that are approximately piecewise-smooth, using triangle-mesh models. The SEMMG method, which is proposed for addressing the mesh-generation problem, is developed based on an earlier work, which uses a greedy-point-insertion (GPI) approach to generate a mesh model with explicit representation of discontinuities (ERD). After in-depth analyses of two existing methods for generating the ERD models, several weaknesses are identified and specifically addressed to improve the quality of the generated models, leading to the proposal of the SEMMG method. The performance of the SEMMG method is then evaluated by comparing the quality of the meshes it produces with those obtained by eight other competing methods, namely, the error-diffusion (ED) method of Yang, the modified Garland-Heckbert (MGH) method, the ERDED and ERDGPI methods of Tu and Adams, the Garcia-Vintimilla-Sappa (GVS) method, the hybrid wavelet triangulation (HWT) method of Phichet, the binary space partition (BSP) method of Sarkis, and the adaptive triangular meshes (ATM) method of Liu. For this evaluation, the error between the original and reconstructed images, obtained from each method under comparison, is measured in terms of the PSNR. Moreover, in the case of the competing methods whose implementations are available, the subjective quality is compared in addition to the PSNR. Evaluation results show that the reconstructed images obtained from the SEMMG method are better than those obtained by the competing methods in terms of both PSNR and subjective quality. More specifically, in the case of the methods with implementations, the results collected from 350 test cases show that the SEMMG method outperforms the ED, MGH, ERDED, and ERDGPI schemes in approximately 100%, 89%, 99%, and 85% of cases, respectively. Moreover, in the case of the methods without implementations, we show that the PSNR of the reconstructed images produced by the SEMMG method are on average 3.85, 0.75, 2, and 1.10 dB higher than those obtained by the GVS, HWT, BSP, and ATM methods, respectively. Furthermore, for a given PSNR, the SEMMG method is shown to produce much smaller meshes compared to those obtained by the GVS and BSP methods, with approximately 65% to 80% fewer vertices and 10% to 60% fewer triangles, respectively. Therefore, the SEMMG method is shown to be capable of producing triangular meshes of higher quality and smaller sizes (i.e., number of vertices or triangles) which can be effectively used for image representation. Besides the superior image approximations achieved with the SEMMG method, this work also makes contributions by addressing the problem of image scaling. For this purpose, the application of triangle-mesh mesh models in image scaling is studied. Some of the mesh-based image-scaling approaches proposed to date employ mesh models that are associated with an approximating function that is continuous everywhere, which inevitably yields edge blurring in the process of image scaling. Moreover, other mesh-based image-scaling approaches that employ approximating functions with discontinuities are often based on mesh simplification where the method starts with an extremely large initial mesh, leading to a very slow mesh generation with high memory cost. In this thesis, however, we propose a new mesh-based image-scaling (MIS) method which firstly employs an approximating function with selected discontinuities to better maintain the sharpness at the edges. Secondly, unlike most of the other discontinuity-preserving mesh-based methods, the proposed MIS method is not based on mesh simplification. Instead, our MIS method employs a mesh-refinement scheme, where it starts from a very simple mesh and iteratively refines the mesh to reach a desirable size. For developing the MIS method, the performance of our SEMMG method, which is proposed for image representation, is examined in the application of image scaling. Although the SEMMG method is not designed for solving the problem of image scaling, examining its performance in this application helps to better understand potential shortcomings of using a mesh generator in image scaling. Through this examination, several shortcomings are found and different techniques are devised to address them. By applying these techniques, a new effective mesh-generation method called MISMG is developed that can be used for image scaling. The MISMG method is then combined with a scaling transformation and a subdivision-based model-rasterization algorithm, yielding the proposed MIS method for scaling grayscale images that are approximately piecewise-smooth. The performance of our MIS method is then evaluated by comparing the quality of the scaled images it produces with those obtained from five well-known raster-based methods, namely, bilinear interpolation, bicubic interpolation of Keys, the directional cubic convolution interpolation (DCCI) method of Zhou et al., the new edge-directed image interpolation (NEDI) method of Li and Orchard, and the recent method of super-resolution using convolutional neural networks (SRCNN) by Dong et al.. Since our main goal is to produce scaled images of higher subjective quality with the least amount of edge blurring, the quality of the scaled images are first compared through a subjective evaluation followed by some objective evaluations. The results of the subjective evaluation show that the proposed MIS method was ranked best overall in almost 67\% of the cases, with the best average rank of 2 out of 6, among 380 collected rankings with 20 images and 19 participants. Moreover, visual inspections on the scaled images obtained with different methods show that the proposed MIS method produces scaled images of better quality with more accurate and sharper edges. Furthermore, in the case of the mesh-based image-scaling methods, where no implementation is available, the MIS method is conceptually compared, using theoretical analysis, to two mesh-based methods, namely, the subdivision-based image-representation (SBIR) method of Liao et al. and the curvilinear feature driven image-representation (CFDIR) method of Zhou et al.
Computational Electromagnetics with MATLAB, Fourth Edition Springer Nature
This volume contains the articles presented at the 18th International Meshing Roundtable (IMR) organized, in part, by Sandia National Laboratories and held October 25-28, 2009 in Salt Lake City, Utah, USA. The volume presents recent results of mesh generation and adaptation which has applications to finite element simulation. It introduces theoretical and novel ideas with practical potential.

Finite Element Mesh Generation CRC Press
Handbook of Grid Generation addresses the use of grids (meshes) in the numerical solutions of partial differential equations by finite elements, finite volume, finite differences, and boundary elements. Four parts divide the chapters: structured grids, unstructured girds, surface definition, and adaption/quality. An introduction to each section provides a roadmap through the material. This handbook covers: Fundamental concepts and approaches Grid generation process Essential mathematical elements from tensor analysis and differential geometry, particularly relevant to curves and surfaces Cells of any shape - Cartesian, structured curvilinear coordinates, unstructured tetrahedra, unstructured hexahedra, or various combinations Separate grids overlaid on one another, communicating data through interpolation Moving boundaries and internal interfaces in the field Resolving gradients and controlling solution error Grid generation codes, both commercial and freeware, as well as representative and illustrative grid configurations Handbook of Grid Generation contains 37 chapters as well as contributions from more than 100 experts from around the world, comprehensively evaluating this expanding field and providing a fundamental orientation for practitioners.
Springer Science & Business Media
This fourth edition of the text reflects the continuing increase in awareness and use of computational electromagnetics and incorporates advances and refinements made in recent years. Most notable among these are the improvements made to the standard algorithm for the finite-difference time-domain (FDTD) method and treatment of absorbing boundary conditions in FDTD, finite element, and transmission-line-matrix methods. It teaches the readers how to pose, numerically analyze, and solve EM problems, to give them the ability to expand their problem-solving skills using a variety of methods, and to prepare them for research in electromagnetism. Includes new homework problems in each chapter. Each chapter is updated with the current trends in CEM. Adds a new appendix on CEM codes, which covers commercial and free codes. Provides updated MATLAB code.
A Two-dimensional Finite Element Mesh Generator and Preprocessor for Fluid Flow Problems in Straight Channels Springer Science & Business Media
With considerations such as complex-dimensional geometries and nonlinearity, the computational solution of partial differential systems has become so involved that it is important to automate decisions that have been normally left to the individual. This book covers such decisions: 1) mesh generation with links to the software generating the domain geometry, 2) solution accuracy and reliability with mesh selection linked to solution generation. This book is suited for mathematicians, computer scientists and engineers and is intended to encourage interdisciplinary interaction between the diverse groups.
Ship Structural Analysis and Design John Wiley & Sons
The report describes a graphics mesh generator and preprocessor system that can be used as a preprocessor for two-dimensional flow problems. TRIFEM 1 provides a simple means of generating triangular finite element meshes of variable density for regions which can be conceptualized as rectangular and/or trapezoidal. A number of options for local mesh refinements, deleting and adding triangles in an interactive fashion, makes this program versatile without complicating its execution. The routines in this code have been implemented on the DECsystem PDP-10 computer with graphic display on the Tektronix 4014 or 4006 terminals. Much of the plotting in these codes is accomplished through the use of DISSPLA software. The TRIFEM 1 routines are written in standard FORTRAN.
Advanced Modeling with the MATLAB Reservoir Simulation Toolbox Walter de Gruyter GmbH & Co KG
For a structure as large ans as complex as a ship there are three levels of structural design, the second and most central of which is the subject of this book. Rationally-based design is design from first principles using the tools of modern engineering science: computer and the methods of structural analysis and optimization which computers have made possible. Thus, the rationally-based approach is ideally suited for preliminary structural design, and it is this approach and this level of design that is the subject of this book.
Mesh Models of Images, Their Generation, and Their Application in Image Scaling Cambridge University Press
This much-anticipated second edition introduces the fundamentals of the finite element method featuring clear-cut examples and an applications-oriented approach. Using the transport equation for heat transfer as the foundation for the governing equations, this new edition demonstrates the versatility of the method for a wide range of applications, including structural analysis and fluid flow. Much attention is given to the development of the discrete set of algebraic equations, beginning with simple one-dimensional problems that can be solved by inspection, continuing to two- and three-dimensional elements, and ending with three chapters describing applications. The increased number of example problems per chapter helps build an understanding of the method to define and organize required initial and boundary condition data for specific problems. In addition to exercises that can be worked out manually, this new edition refers to user-friendly computer codes for solving one-, two-, and three-dimensional problems. Among the first FEM textbooks to include finite element software, the book contains a website with access to an even more comprehensive list of finite element software written in FEMLAB, MAPLE, MathCad, MATLAB, FORTRAN, C++, and JAVA - the most popular programming languages. This textbook is valuable for senior level undergraduates in mechanical, aeronautical, electrical, chemical, and civil engineering. Useful for short courses and home-study learning, the book can also serve as an introduction for first-year graduate students new to finite element coursework and as a refresher for industry professionals. The book is a perfect lead-in to Intermediate Finite Element Method: Fluid Flow and Heat and Transfer Applications (Taylor & Francis, 1999, Hb 1560323094).
Proceedings of the American Physical Society Topical Conference Held in Williamsburg, Virginia, June 17-20, 1991 Springer Science & Business Media
The papers in this volume were selected for presentation at the 15th International Meshing Roundtable, held September 17–20, 2006 in Birmingham, Alabama, U.S.A.. The conference was started by Sandia National Laboratories in 1992 as a small meeting of organizations striving to establish a common focus for research and development in the field of mesh generation. Now after 15 consecutive years, the International Meshing Roundtable has become recognized as an international focal point annually attended by researchers and developers from dozens of countries

around the world. The 15th International Meshing Roundtable consists of technical presentations from contributed papers, keynote and invited talks, short course presentations, and a poster session and competition. The Program Committee would like to express its appreciation to all who participate to make the IMR a successful and enriching experience. The papers in these proceedings were selected from among 42 submissions by the Program Committee. Based on input from peer reviews, the committee selected these papers for their perceived quality, originality, and appropriateness to the theme of the International Meshing Roundtable. The Program Committee would like to thank all who submitted papers. We would also like to thank the colleagues who provided reviews of the submitted papers. The names of the reviewers are acknowledged in the following pages. As Program Chair, I would like to extend special thanks to the Program Committee and to the Conference Coordinators for their time and effort to make the 15th IMR another outstanding conference.

Proceedings of the 6th Annual ESPRIT Conference, Brussels, November 27 – December 1, 1989 CRC Press

This book aims at informing on new trends, challenges and solutions, in the multidisciplinary field of biomedical engineering. It covers traditional biomedical engineering topics, as well as innovative applications such as artificial intelligence in health care, tissue engineering , neurotechnology and wearable devices. Further topics include mobile health and electroporation-based technologies, as well as new treatments in medicine. Gathering the proceedings of the 8th European Medical and Biological Engineering Conference (EMBEC 2020), held on November 29 - December 3, 2020, in Portorož, Slovenia, this book bridges fundamental and clinically-oriented research, emphasizing the role of education, translational research and commercialization of new ideas in biomedical engineering. It aims at inspiring and fostering communication and collaboration between engineers, physicists, biologists, physicians and other professionals dealing with cutting-edge themes in and advanced technologies serving the broad field of biomedical engineering.

User Manual for the PROTEUS Mesh Tools Academic Press

All relevant implementation aspects of finite element methods are discussed in this book. The focus is on algorithms and data structures as well as on their concrete implementation. Theory is covered only as far as it gives insight into the construction of algorithms. In the exercises, a complete FE-solver for stationary 2D problems is implemented in Matlab/Octave. Contents: Finite Element Fundamentals Grids and Finite Elements Assembly Solvers Error Estimation Mesh Refinement Multigrid Elastomechanics Fluid Mechanics Grid Data Structure Function Reference

The Finite Element Method Set Elsevier

Written by authors at the forefront of modern algorithms research, Delaunay Mesh Generation demonstrates the power and versatility of Delaunay meshers in tackling complex geometric domains ranging from polyhedra with internal boundaries to piecewise smooth surfaces. Covering both volume and surface meshes, the authors fully explain how and why these meshing algorithms work. The book is one of the first to integrate a vast amount of cutting-edge material on Delaunay triangulations. It begins with introducing the problem of mesh generation and describing algorithms for constructing Delaunay triangulations. The authors then present algorithms for generating high-quality meshes in polygonal and polyhedral domains. They also illustrate how to use restricted Delaunay triangulations to extend the algorithms to surfaces with ridges and patches and volumes with smooth surfaces. For researchers and graduate students, the book offers a rigorous theoretical analysis of mesh generation methods. It provides the necessary mathematical foundations and core theoretical results upon which researchers can build even better algorithms in the future. For engineers, the book shows how the algorithms work well in practice. It explains how to effectively implement them in the design and programming of mesh generation software.

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