

# Numerical methods and algorithms

1. Special format of graph description was constructed. It allows user to pay no attention to the way how solver treats the topology of vascular graph.

2. Conservative finite-difference scheme with second order of approximation on each arch of graph was taken as a base. At the same time scheme is homogeneous, so it does not depends upon concrete arch.

3. Two different variants of finite-difference schemes provided for better reliability of numerical calculations.

4. The total non-linear system of equations is solved with help of iteration methods (Newton method, successive iterations on coefficients of equations).

5. The obtained linear system of equations is solved mainly by direct methods.

$$\hat{p}_j^k + As_j^3 \hat{\rho}_{j+1}^k + Bs_j^1 \hat{u}_{j-1}^k + Bs_j^2 \hat{u}_j^k + Bs_j^3 \hat{u}_{j+1}^k = -Fs_j$$

$$1_j^k = -\left(\frac{u_{j-1}^k}{2} + \frac{a_{j-1/2}^k}{h}\right) \frac{\sigma_1 \tau}{h} \theta_{j-1}^k,$$

$$2_j^k = (1 + (a_{j+1/2}^k + a_{j-1/2}^k) \frac{\sigma_1 \tau}{h^2}) G$$

$$3_j^k = \left(\frac{u_{j+1}^k}{2} - \frac{a_{j+1/2}^k}{h}\right) \frac{\sigma_1 \tau}{h} \theta_{j+1}^k,$$

$$Bs_j^1 = -\frac{\sigma_1 \tau}{2h} s_{j-1}^k,$$

$$Bs_j^2 = 0,$$

$$Bs_j^3 = \frac{\sigma_1 \tau}{2h} s_{j+1}^k,$$

$$-\bar{s} + (s_{j+1}^k u_{j+1}^k - s_{j-1}^k u_{j-1}^k) \frac{\sigma_1 \tau}{2h} + (\bar{s}_{j+1} \bar{u}_{j+1} - \bar{s}_{j-1} \bar{u}_{j-1}) \frac{(1-\sigma_1)\tau}{2h} -$$

$$-(a_{j+1}^k s_{j+1}^k - (a_{j+1/2}^k + a_{j-1/2}^k) s_j^k + a_{j-1/2}^k s_{j-1}^k) \frac{\sigma_1 \tau}{h^2} -$$

$$-(\bar{a}_{j+1/2} \bar{s}_{j+1} - (\bar{a}_{j+1/2} + \bar{a}_{j-1/2}) \bar{s}_j + \bar{a}_{j-1/2} \bar{s}_{j-1}) \frac{(1-\sigma_1)\tau}{h^2}.$$

# Numerical Calculations Algorithms

**Bruce W. Arden, Kenneth N. Astill**



## **Numerical Calculations Algorithms:**

**Numerical Algorithms with C** Giesela Engeln-Müllges, Frank Uhlig, 1996-07-02 CD ROM contains all computer codes a compiler and a test bed of programs and data for most of the algorithms

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Numerical Methods Anne Greenbaum, Tim P. Chartier, 2012-04-01 A rigorous and comprehensive introduction to numerical analysis Numerical Methods provides a clear and concise exploration of standard numerical analysis topics as well as nontraditional ones including mathematical modeling Monte Carlo methods Markov chains and fractals Filled with appealing examples that will motivate students the textbook considers modern application areas such as information retrieval and animation and classical topics from physics and engineering Exercises use MATLAB and promote understanding of computational results The book gives instructors the flexibility to emphasize different aspects design analysis or computer implementation of numerical algorithms depending on the background and interests of students Designed for upper division undergraduates in mathematics or computer science classes the textbook assumes that students have prior knowledge of linear algebra and calculus although these topics are reviewed in the text Short discussions of the history of numerical methods are interspersed throughout the chapters The book also includes polynomial interpolation at Chebyshev points use of the MATLAB package Chebfun and a section on the fast Fourier transform Supplementary materials are available online Clear and concise exposition of standard numerical analysis topics Explores nontraditional topics such as mathematical modeling and Monte Carlo methods Covers modern applications including information retrieval and animation and classical applications from physics and engineering Promotes understanding of computational results through MATLAB exercises Provides flexibility so instructors can emphasize mathematical or applied computational aspects of numerical methods or a combination Includes recent results on polynomial interpolation at Chebyshev points and use of the MATLAB package Chebfun Short discussions of the history of numerical methods interspersed throughout Supplementary materials available online

**Numerical Calculations and Algorithms** Royce Beckett, 1968

**Numerical Computations: Theory and Algorithms** Yaroslav D. Sergeyev, Dmitri E. Kvasov, Annabella Astorino, 2024-12-31 The three volume set LNCS 14476 14478 constitutes the post conference proceedings of the 4th International Conference on Numerical Computations Theory and Algorithms NUMTA 2023 held in Pizzo Calabro Italy during June 14 20 2023 The 45 full papers presented in this book together with 60 short papers were carefully reviewed and selected from 170 submissions The papers focus on topics such as continuous and discrete single and multi objective problems local global and large scale optimization classification in machine learning optimal control and applications

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*Compact Numerical Methods for Computers* John C. Nash, 1990-01-01 This second edition of *Compact Numerical Methods for Computers* presents reliable yet compact algorithms for computational problems As in the previous edition the author considers specific mathematical problems of wide applicability develops approaches to a solution and the consequent algorithm and provides the program steps He emphasizes useful applicable methods from various scientific research fields ranging from mathematical physics to commodity production modeling While the ubiquitous personal computer is the particular focus the methods have been implemented on computers as small as a programmable pocket calculator and as large as a highly parallel supercomputer New to the Second Edition Presents program steps as Turbo Pascal code Includes more algorithmic examples Contains an extended bibliography The accompanying software available by coupon at no charge includes not only the algorithm source codes but also driver programs example data and several utility codes to help in the software engineering of end user programs The codes are designed for rapid implementation and reliable use in a wide variety of computing environments Scientists statisticians engineers and economists who prepare modify programs for use in their work will find this resource invaluable Moreover since little previous training in numerical analysis is required the book can also be used as a supplementary text for courses on numerical methods and mathematical software

**Numerical Simulation Algorithm of Electromagnetic Field for Grounding Problems in Power System Substation Grounding Grids** Zhong-Xin Li, 2025-04-01 This book focuses on numerical methods for grounding problems in substation grounding systems which are rooted in horizontal multilayered earth models The book discusses both theories and engineering applications and provides case studies to verify the accuracy of the methods introduced Up to ten horizontal multilayered soil models were considered This book employs numerical algorithms for Galerkin s method including Galerkin s method of moments Galerkin s boundary element method and hybrid algorithms based on a variety of basis functions that have emerged as a result of simplifying Galerkin s method of moments These numerical methods include both frequency and time domain algorithms that can be used to numerically simulate transient and steady state grounding problems in substation grounding grids The most outstanding feature of this book is the incorporation of the frequency and time domain quasi static complex imaging method QSCIM for point current sources in layered conducting media and its closed form Green s function as well as analytical algorithms for calculating the spatial two dimensional line integrals of mutual impedances and inductances into numerical algorithmic modeling of electromagnetic fields which greatly improves computational speed and accuracy

*Introduction to Numerical Analysis* Josef Stoer, R. Bulirsch, 2002-08-21 New edition of a well known classic in the field Previous edition sold over 6000 copies worldwide Fully worked examples Many carefully selected problems

**Numerical Computation 1** Christoph W. Ueberhuber, 2012-12-06 This book deals with various aspects of scientific numerical computing No attempt was made to be complete or encyclopedic The successful solution of a numerical problem has many facets and consequently involves different fields of computer science Computer numerics as opposed to computer algebra is thus based on applied mathematics numerical analysis and numerical computation as well as on certain areas of computer science such as computer architecture and operating systems Applied Mathematics I I I Numerical Analysis Analysis Algebra I I Numerical Computation Symbolic Computation I Operating Systems Computer Hardware Each chapter begins with sample situations taken from specific fields of application Abstract and general formulations of mathematical problems are then presented Following this abstract level a general discussion about principles and methods for the numerical solution of mathematical problems is presented Relevant algorithms are developed and their efficiency and the accuracy of their results is assessed It is then explained as to how they can be obtained in the form of numerical software The reader is presented with various ways of applying the general methods and principles to particular classes of problems and approaches to extracting practically useful solutions with appropriately chosen numerical software are developed Potential difficulties and obstacles are examined and ways of avoiding them are discussed The volume and diversity of all the available numerical software is tremendous

*Numerical Analysis with Algorithms and Programming* Santanu Saha Ray, 2018-09-03 Numerical Analysis with Algorithms and Programming is the first comprehensive textbook to provide detailed coverage of numerical methods their algorithms and corresponding computer programs It presents many techniques for the efficient numerical solution of problems in science and engineering Along with numerous worked out examples end of chapter exercises and Mathematica programs the book includes the standard algorithms for numerical computation Root finding for nonlinear equations Interpolation and approximation of functions by simpler computational building blocks such as polynomials and splines The solution of systems of linear equations and triangularization Approximation of functions and least square approximation Numerical differentiation and divided differences Numerical quadrature and integration Numerical solutions of ordinary differential equations ODEs and boundary value problems Numerical solution of partial differential equations PDEs The text develops students understanding of the construction of numerical algorithms and the applicability of the methods By thoroughly studying the algorithms students will discover how various methods provide accuracy efficiency scalability and stability for large scale systems

**Control Perspectives on Numerical Algorithms and Matrix Problems** Amit Bhaya, Eugenius Kaszkurewicz, 2006-03-01 This book organizes the analysis and design of iterative numerical methods from a control perspective A variety of applications are discussed including iterative methods for linear and nonlinear systems of equations neural networks for linear and quadratic programming problems and integration and shooting methods for

ordinary differential equations      *Accuracy and Stability of Numerical Algorithms* Nicholas J. Higham, 2002-08-01 *Accuracy and Stability of Numerical Algorithms* gives a thorough up to date treatment of the behavior of numerical algorithms in finite precision arithmetic It combines algorithmic derivations perturbation theory and rounding error analysis all enlivened by historical perspective and informative quotations This second edition expands and updates the coverage of the first edition 1996 and includes numerous improvements to the original material Two new chapters treat symmetric indefinite systems and skew symmetric systems and nonlinear systems and Newton s method Twelve new sections include coverage of additional error bounds for Gaussian elimination rank revealing LU factorizations weighted and constrained least squares problems and the fused multiply add operation found on some modern computer architectures      *Numerical Methods for Engineers and Scientists* Joe D. Hoffman, Steven Frankel, 2018-10-03 Emphasizing the finite difference approach for solving differential equations the second edition of *Numerical Methods for Engineers and Scientists* presents a methodology for systematically constructing individual computer programs Providing easy access to accurate solutions to complex scientific and engineering problems each chapter begins with objectives a discussion of a representative application and an outline of special features summing up with a list of tasks students should be able to complete after reading the chapter perfect for use as a study guide or for review The AIAA Journal calls the book a good solid instructional text on the basic tools of numerical analysis

**Numerical Algorithms with C** Giesela Engeln-Müllges, Frank Uhlig, 2013-11-21 More scientists now use C than any other programming language This book contains practical computer ready algorithms for many standard methods of numerical mathematics It describes the principles of the various methods and provides support in choosing the appropriate method for a given task Topics given special emphasis include converging methods for solving nonlinear equations methods for solving systems of linear equations for many special matrix structures and the Shepard method for multidimensional interpolation The CD contains C programs for almost all the algorithms given in the book and a compiler together with software for graphical printing      *Algorithms for Elliptic Problems* Marián Vajtersic, 1993-04-30 This volume deals with problems of modern effective algorithms for the numerical solution of the most frequently occurring elliptic partial differential equations From the point of view of implementation attention is paid to algorithms for both classical sequential and parallel computer systems The first two chapters are devoted to fast algorithms for solving the Poisson and biharmonic equation In the third chapter parallel algorithms for model parallel computer systems of the SIMD and MIMD types are described The implementation aspects of parallel algorithms for solving model elliptic boundary value problems are outlined for systems with matrix pipeline and multiprocessor parallel computer architectures A modern and popular multigrid computational principle which offers a good opportunity for a parallel realization is described in the next chapter More parallel variants based in this idea are presented whereby methods and assignments strategies for hypercube systems are treated in more detail The last chapter presents VLSI designs for solving special tridiagonal linear systems of equations

arising from finite difference approximations of elliptic problems For researchers interested in the development and application of fast algorithms for solving elliptic partial differential equations using advanced computer systems

*Numerical Algorithms: Origins and Applications* Bruce W. Arden, Kenneth N. Astill, 1970      Advanced Numerical Methods with Matlab 1 Bouchaib Radi, Abdelkhalak El Hami, 2018-03-15 Most physical problems can be written in the form of mathematical equations differential integral etc Mathematicians have always sought to find analytical solutions to the equations encountered in the different sciences of the engineer mechanics physics biology etc These equations are sometimes complicated and much effort is required to simplify them In the middle of the 20th century the arrival of the first computers gave birth to new methods of resolution that will be described by numerical methods They allow solving numerically as precisely as possible the equations encountered resulting from the modeling of course and to approach the solution of the problems posed The approximate solution is usually computed on a computer by means of a suitable algorithm The objective of this book is to introduce and study the basic numerical methods and those advanced to be able to do scientific computation The latter refers to the implementation of approaches adapted to the treatment of a scientific problem arising from physics meteorology pollution etc or engineering structural mechanics fluid mechanics signal processing etc

Elementary Numerical Analysis S. D. Conte, Carl De Boor, 2018-02-27 This book provides a thorough and careful introduction to the theory and practice of scientific computing at an elementary yet rigorous level from theory via examples and algorithms to computer programs The original FORTRAN programs have been rewritten in MATLAB and now appear in a new appendix and online offering a modernized version of this classic reference for basic numerical algorithms

**Numerical Algorithms** Justin Solomon, 2015-06-24 Numerical Algorithms Methods for Computer Vision Machine Learning and Graphics presents a new approach to numerical analysis for modern computer scientists Using examples from a broad base of computational tasks including data processing computational photography and animation the textbook introduces numerical modeling and algorithmic design

## Reviewing **Numerical Calculations Algorithms**: Unlocking the Spellbinding Force of Linguistics

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