Numerische Methoden
Lösungsvorschläge zur Modulprüfung

Aufgabe 1   (10 + 10 = 20 Punkte)

Gegeben seien

$$\text{die Matrix } A = \begin{pmatrix} 4 & 0 & 14 \\ 0 & 9 & 27 \\ 14 & 27 & 251 \end{pmatrix} \text{ und der Vektor } b = \begin{pmatrix} 210 \\ 477 \\ 3981 \end{pmatrix}.$$

(a) Bestimmen Sie die Cholesky-Zerlegung der Matrix A.

(b) Lösen Sie mithilfe der in (a) bestimmten Cholesky-Zerlegung das lineare Gleichungssystem $Ax = b$.

Lösung von Aufgabe 1

(a) Wir gehen Schrittweise vor wie in Algorithmus 1.20. Zu berechnen ist die Matrix:

$$L = \begin{pmatrix} l_{11} & 0 & 0 \\ l_{21} & l_{22} & 0 \\ l_{31} & l_{32} & l_{33} \end{pmatrix}.$$

Schritt 1. $i = 1$: Hier haben wir nur

$$l_{11} = \sqrt{a_{11}} = \sqrt{4} = 2.$$

Damit haben wir die Matrix

$$L = \begin{pmatrix} 2 & 0 & 0 \\ l_{21} & l_{22} & 0 \\ l_{31} & l_{32} & l_{33} \end{pmatrix}.$$

Schritt 2. $i = 2$: Hier berechnen wir

$$l_{21} = \frac{a_{21}}{l_{11}} = \frac{0}{2} = 0, \quad l_{22} = \sqrt{a_{22} - |l_{21}|^2} = \sqrt{9 - 0^2} = \sqrt{9 - 0} = \sqrt{9} = 3,$$
$$l_{31} = \frac{a_{31}}{l_{11}} = \frac{14}{2} = 7.$$

Damit haben wir die Matrix

$$L = \begin{pmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 7 & l_{32} & l_{33} \end{pmatrix}.$$

Schritt 3. $i = 3$: Hier berechnen wir

$$l_{32} = \frac{1}{l_{22}} \left(a_{32} - l_{31}\overline{l_{21}} \right) = \frac{1}{3} (27 - 7 \cdot 0) = \frac{27 - 7 \cdot 0}{3} = \frac{27 - 0}{3} = \frac{27}{3} = 9,$$
$$l_{33} = \sqrt{a_{33} - |l_{31}|^2 - |l_{32}|^2} = \sqrt{251 - 7^2 - 9^2} = \sqrt{251 - 49 - 81} = \sqrt{121} = 11.$$

Damit haben wir die Matrix

$$L = \begin{pmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 7 & 9 & 11 \end{pmatrix} \in \mathbb{R}^{3 \times 3}$$

mit

$$A = LL^H = LL^T.$$

Numerische Methoden 1

H. Heinrich,G. Schmid

Numerische Methoden 1:

Bifurcation Problems and their Numerical Solution H. D. Mittelmann,H. Weber,1980 **One-Dimensional Finite Elements** Markus Merkel,Andreas Öchsner,2023-12-28 The basic idea of this introduction to the finite element method is based on the concept of explaining the complex method using only one dimensional elements Thus the mathematical description remains largely simple and straightforward The emphasis in each chapter is on explaining the method and understanding it itself The reader learns to understand the assumptions and derivations in various physical problems in structural mechanics and to critically assess the possibilities and limitations of the finite element method The restriction to one dimensional elements thus enables the methodical understanding of important topics e g plasticity or composite materials which a prospective computational engineer encounters in professional practice but which are rarely treated in this form at universities Thus an easy entry also into more advanced application areas is ensured by the concept of a introduction to the basics b exact derivation with restriction to one dimensional elements and in many cases also to one dimensional problems c extensive examples and advanced tasks with short solution in the appendix For illustration purposes each chapter is deepened with extensively calculated and commented examples as well as with further tasks including short solutions

Konstruktive Methoden der finiten nichtlinearen Optimierung Günther Meinardus,Wolfgang Wetterling,1980 **Integer Programming and Related Areas A Classified Bibliography 1976–1978** D. Hausmann,2012-12-06 *Non-Linear Parametric Optimization* BANK,GUDDAT,KLATTE,KUMMER,TAMMER,2013-12-21 *1985* H. Heinrich,G. Schmid,2022-02-07 No detailed description available for 1985 *Integer Programming and Related Areas* R.v. Randow,2012-12-06 **Introduction to SIMULA 67** Lamprecht Günther,2013-04-17 Iterative Solution of Large Sparse Systems of Equations Wolfgang Hackbusch,2016-06-21 In the second edition of this classic monograph complete with four new chapters and updated references readers will now have access to content describing and analysing classical and modern methods with emphasis on the algebraic structure of linear iteration which is usually ignored in other literature The necessary amount of work increases dramatically with the size of systems so one has to search for algorithms that most efficiently and accurately solve systems of e g several million equations The choice of algorithms depends on the special properties the matrices in practice have An important class of large systems arises from the discretization of partial differential equations In this case the matrices are sparse i e they contain mostly zeroes and well suited to iterative algorithms The first edition of this book grew out of a series of lectures given by the author at the Christian Albrecht University of Kiel to students of mathematics The second edition includes quite novel approaches *Methods of Numerical Integration* Philip J. Davis,Philip Rabinowitz,2014-05-10 Methods of Numerical Integration Second Edition describes the theoretical and practical aspects of major methods of numerical integration Numerical integration is the study of how the numerical value of an integral can be found This book contains six chapters and begins with a discussion of the basic

principles and limitations of numerical integration The succeeding chapters present the approximate integration rules and formulas over finite and infinite intervals These topics are followed by a review of error analysis and estimation as well as the application of functional analysis to numerical integration A chapter describes the approximate integration in two or more dimensions The final chapter looks into the goals and processes of automatic integration with particular attention to the application of Tschebyscheff polynomials This book will be of great value to theoreticians and computer programmers

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wideband sources transmission lines pick up noise currents generated by external electromagnetic fields These are superimposed on essential signals the lines acting not only as receiving antennas but radiating parts of the signal energy into the environment This book is outstanding in its originality While many textbooks rephrase that which has been written before this book features an accessible introduction to the fundamentals of electromagnetics an explanation of the newest developments in transmission line theory featuring the transmission line super theory developed by the authors a unique exposition of the increasingly popular PEEC partial element equivalent circuit method including recent research results Both the Transmission Line Theory and the PEEC method are well suited to combine linear structures with circuit networks For engineers researchers and graduate students this text broadens insight into the basics of electrical engineering It provides a deeper understanding of Maxwellian circuit like representations of multi conductor transmission lines justifies future research in this field   *Zeitschrift für Angewandte Mathematik und Mechanik. Volume 69, Number 9* H. Heinrich,G. Schmid,2022-03-21 No detailed description available for Z ANGEW MATH MECH BD 69 9 ZAMM E BOOK   **Operations Research '91** Peter Gritzmann,Rainer Hettich,Reiner Horst,Ekkehard Sachs,2012-12-06 The volume comprises a collection of 172 extented abstracts of talks presented at the 16th Symposium on Operations Rese arch held at the University of Trier in September 1991 It is designated to serve as a quickly published documentation of the scientific activities of the conference Subjects and areas touched upon include theory modelling and computational methods in optimization combinatorial op timization and discrete mathematics combinatorial problems in VLSI scientific computing stochastic and dynamic opti mization queuing scheduling stochastics and econometrics mathematical economics and game theory utility risk insu rance financial engineering computer science in business and economics knowledge engineering and production and ma nufacturing   One-Dimensional Finite Elements Andreas Öchsner,Markus Merkel,2018-04-25 This textbook presents finite element methods using exclusively one dimensional elements It presents the complex methodology in an easily understandable but mathematically correct fashion The approach of one dimensional elements enables the reader to focus on the understanding of the principles of basic and advanced mechanical problems The reader will easily understand the assumptions and limitations of mechanical modeling as well as the underlying physics without struggling with complex mathematics Although the description is easy it remains scientifically correct The approach using only one dimensional elements covers not only standard problems but allows also for advanced topics such as plasticity or the mechanics of composite materials Many examples illustrate the concepts and problems at the end of every chapter help to familiarize with the topics Each chapter also includes a few exercise problems with short answers provided at the end of the book The second edition appears with a complete revision of all figures It also presents a complete new chapter special elements and added the thermal conduction into the analysis of rod elements The principle of virtual work has also been introduced for the derivation of the finite element principal equation   Integer Programming and Related Areas C. Kastning,2013-11-11

Integer Prograw ing is one of the most fascinating and difficult areas in the field of Mathematical Optimization Due to this fact notable research contributions to Integer Programming have been made in very different branches of mathematics and its applications Since these publications are scattered over many journals proceedings volumes monographs and working papers a comprehensive bibliography of all these sources is a helpful tool even for specialists in this field I initiated this compilation of literature in 1970 at the Institut fur konometrie und Operations Research University of Bonn Since then many collaborators have contributed to and worked on it Among them Dipl Math Claus Kastning has done the bulk of the work With great perseverance and diligence he has gathered all the material and checked it with the original sources The main aim was to incorporate rare and not easily accessible sources like Russian journals preprints or unpublished papers Without the invaluable and dedicated engagement of Claus Kastning the bibliography would never have reached this final version For this reason he must be considered its responsible editor As with any other collection this literature list has a subjective viewpoint and may be in some sense incomplete We have however tried to be as complete as possible The bibliography contains 4704 different publications by 6767 authors which were classified by 11839 descriptor entries **Structural Mechanics in Lightweight Engineering** Christian Mittelstedt,2021-07-01 This book provides a comprehensive yet concise presentation of the analysis methods of lightweight engineering in the context of the statics of beam structures and is divided into four sections Starting from very general remarks on the fundamentals of elasticity theory the first section also addresses plane problems as well as strength criteria of isotropic materials The second section is devoted to the analytical treatment of the statics of beam structures addressing beams under bending shear and torsion The third section deals with the work and energy methods in lightweight construction spanning classical methods and modern computational methods such as the finite element method Finally the fourth section addresses more advanced beam models discussing hybrid structures as well as laminated and sandwich beams in addition to shear field beams and shear deformable beams This book is intended for students at technical colleges and universities as well as for engineers in practice and researchers in engineering Rock Characterization John A. Hudson,1992

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