

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 Schrittwiese 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

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

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

Karl-Eugen Kurrer

A red circular graphic with a gradient, appearing as a semi-circle or a partial circle, located to the right of the author's name.

Numerische Methoden 1:

Bifurcation Problems and their Numerical Solution H. D. Mittelman, H. Weber, 1980 *Integer Programming and Related Areas* R.v. Randow, 2012-12-06 *18th European Symposium on Computer Aided Process Engineering* Bertrand Braunschweig, Xavier Joulia, 2008-05-15 The 18th European Symposium on Computer Aided Process Engineering contains papers presented at the 18th European Symposium of Computer Aided Process Engineering ESCAPE 18 held in Lyon France from 14 June 2008 The ESCAPE series brings the latest innovations and achievements by leading professionals from the industrial and academic communities The series serves as a forum for engineers scientists researchers managers and students from academia and industry to present new computer aided methods algorithms techniques related to process and product engineering discuss innovative concepts new challenges needs and trends in the area of CAPE This research area bridges fundamental sciences physics chemistry thermodynamics applied mathematics and computer sciences with the various aspects of process and product engineering The special theme for ESCAPE 18 is CAPE for the Users CAPE systems are to be put in the hands of end users who need functionality and assistance beyond the scientific and technological capacities which are at the core of the systems The four main topics are off line systems for synthesis and design on line systems for control and operation computational and numerical solutions strategies integrated and multi scale modelling and simulation Two general topics address the impact of CAPE tools and methods on Society and Education CD ROM that accompanies the book contains all research papers and contributions International in scope with guest speeches and keynote talks from leaders in science and industry Presents papers covering the latest research key top areas and developments in Computer Aided Process Engineering 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 Operations Research '91 Peter Gritzmam, Rainer Hettich, Reiner Horst, Ekkehard Sachs, 2012-12-06 The volume comprises a collection of 172 extended abstracts of talks

presented at the 16th Symposium on Operations Research 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 optimization and discrete mathematics, combinatorial problems in VLSI, scientific computing, stochastic and dynamic optimization, queueing, scheduling, stochastic and econometrics, mathematical economics and game theory, utility, risk insurance, financial engineering, computer science in business and economics, knowledge engineering and production and manufacturing.

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 an introduction to the basics, by exact derivation with restriction to one-dimensional elements and in many cases also to one-dimensional problems, by extensive examples and advanced tasks with short solutions 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.

Integer Programming and Related Areas: A Classified Bibliography 1976-1978 D. Hausmann, 2012-12-06 1985 H. Heinrich, G. Schmid, 2022-02-07. No detailed description available for 1985.

Computational Fluid and Solid Mechanics 2003 K.J. Bathe, 2003-06-02. Bringing together the world's leading researchers and practitioners of computational mechanics, these new volumes meet and build on the eight key challenges for research and development in computational mechanics. Researchers have recently identified eight critical research tasks facing the field of computational mechanics. These tasks have come about because it appears possible to reach a new level of mathematical modelling and numerical solution that will lead to a much deeper understanding of nature and to great improvements in engineering design. The eight tasks are: The automatic solution of mathematical models, Effective numerical schemes for fluid flows, The development of an effective mesh-free numerical solution method, The development of numerical procedures for multiphysics problems, The development of numerical procedures for multiscale problems, The modelling of uncertainties, The analysis of complete life cycles of systems, Education teaching sound engineering and scientific judgement. Readers of *Computational Fluid and Solid Mechanics 2003* will be able to apply the combined experience of many of the world's leading researchers to their own research needs. Those in academic environments will gain a better insight into the needs and constraints of the industries they are involved with.

those in industry will gain a competitive advantage by gaining insight into the cutting edge research being carried out by colleagues in academia Features Bridges the gap between academic researchers and practitioners in industry Outlines the eight main challenges facing Research and Design in Computational mechanics and offers new insights into the shifting the research agenda Provides a vision of how strong basic and exciting education at university can be harmonized with life long learning to obtain maximum value from the new powerful tools of analysis **Introduction to SIMULA 67** Lamprecht

Günther,2013-04-17 Konstruktive Methoden der finiten nichtlinearen Optimierung Günther Meinardus,Wolfgang

Wetterling,1980 **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 Zeitschrift für Angewandte Mathematik und Mechanik.

Volume 64, Number 11 H. Heinrich,G. Schmid,2022-03-21 No detailed description available for ZEITSCHR ANGEW MATH

MECH VOL 64 11 ZAMM E BOOK **The History of the Theory of Structures** Karl-Eugen Kurrer,2018-06-19 Zehn Jahre

nach der 1 Auflage in englischer Sprache legt der Autor sein Buch The History of the Theory of Structures in wesentlich erweiterter Form vor nunmehr mit dem Untertitel Searching for Equilibrium Mit dem vorliegenden Buch l dt der Verfasser seine Leser zur Suche nach dem Gleichgewicht von Tragwerken auf Zeitreisen ein Die Zeitreisen setzen mit der Entstehung der Statik und Festigkeitslehre eines Leonardo und Galilei ein und erreichen ihren ersten H hepunkt mit den baustatischen Theorien ber den Balken Erddruck und das Gew lbe von Coulomb am Ende des 18 Jahrhunderts Im folgenden Jahrhundert formiert sich die Baustatik mit Navier Culmann Maxwell Rankine Mohr Castigliano und M ller Breslau zu einer technikwissenschaftlichen Grundlagendisziplin die im 20 Jahrhundert in Gestalt der modernen Strukturmechanik bei der Herausbildung der konstruktiven Sprache des Stahl Stahlbeton Flugzeug Automobil und des Schiffbaus eine tragende Rolle spielt Dabei setzt der Autor den inhaltlichen Schwerpunkt auf die Formierung und Entwicklung moderner numerischer Ingenieurmethoden wie der Finite Elemente Methode und beschreibt ihre disziplin re Integration in der Computational Mechanics Kurze durch historische Skizzen unterst tzte Einblicke in g ngige Berechnungsverfahren erleichtern den Zugang zur Geschichte der Strukturmechanik und Erddrucktheorie vom heutigen Stand der Ingenieurpraxis und stellen einen auch einen wichtigen Beitrag zur Ingenieurp dagogik dar Dem Autor gelingt es die Unterschiedlichkeit der Akteure hinsichtlich

ihres technisch wissenschaftlichen Profils und ihrer Persönlichkeit plastisch zu schildern und das Verständnis für den gesellschaftlichen Kontext zu erzeugen. So werden in 260 Kurzbiografien die subjektive Dimension der Baustatik und der Strukturmechanik von der frühen Neuzeit bis heute entfaltet. Dabei werden die wesentlichen Beiträge der Protagonisten der Baustatik besprochen und in die nachfolgende Bibliografie integriert. Berücksichtigt wurden nicht nur Bauingenieure und Architekten sondern auch Mathematiker, Physiker, Maschinenbauer sowie Flugzeug- und Schiffbauer. Neben den bekannten Persönlichkeiten der Baustatik wie Coulomb, Culmann, Maxwell, Mohr, Müller-Breslau, Navier, Rankine, Saint-Venant, Timoshenko und Westergaard wurden u.a. auch G. Green, A. N. Krylov, G. Li, A. J. S. Pippard, W. Prager, H. A. Schade, A. W. Skempton, C. A. Truesdell, J. A. L. Waddell und H. Wagner berücksichtigt. Den Wegbereitern der Moderne in der Baustatik J. H. Argyris, R. W. Clough, Th. v. Karmann, M. J. Turner und O. C. Zienkiewicz wurden umfangreiche Biografien gewidmet. Eine ca. 4500 Titel umfassende Bibliografie rundet das Werk ab. Neue Inhalte der 2. Auflage sind: Erddrucktheorie, Traglastverfahren, historische Lehrbuchanalyse, Stahlbrückenbau, Leichtbau, Platten und Schalentheorie, Greensche Funktion, Computerstatik, FEM, Computergestützte Graphostatik und Historische Technikwissenschaft. Gegenüber der 1. englischen Ausgabe wurde der Seitenumfang um 50 % auf nunmehr etwas über 1200 Druckseiten gesteigert. Das vorliegende Buch ist die erste zusammenfassende historische Gesamtdarstellung der Baustatik vom 16. Jahrhundert bis heute. Die Reihe „edition Bautechnikgeschichte“ mit erstaunlicher Dynamik hat sich die Bautechnikgeschichte in den vergangenen Jahrzehnten zu einer höchst lebendigen, international vernetzten und viel beachteten eigenständigen Disziplin entwickelt. Auch wenn die nationalen Forschungszugänge unterschiedliche Akzente setzen, eint sie doch das Bewusstsein, dass gerade die inhaltliche und methodische Vielfalt und das damit verbundene synthetische Potenzial die Stärke des neuen Forschungsfeldes ausmachen. Bautechnikgeschichte erschließt neue Formen des Verstehens von Bauen zwischen Ingenieurwesen und Architektur, zwischen Bau und Kunst, Technik und Wissenschaftsgeschichte. Mit der „edition Bautechnikgeschichte“ erhält die neue Disziplin erstmals einen Ort für die Publikation wichtiger Arbeiten auf angemessenem Niveau in hochwertiger Gestaltung. Die Bücher erscheinen in deutscher oder englischer Sprache. Beide Hauptrichtungen der Bautechnikgeschichte, der eher konstruktionsgeschichtlich und der eher theoriegeschichtlich geleitete Zugang, finden Berücksichtigung. Das Spektrum der Bände reicht von Überblickswerken über Monographien zu Einzelaspekten oder Bauten bis hin zu Biographien bedeutender Ingenieurpersönlichkeiten. Ein international besetzter Wissenschaftlicher Beirat unterstützt die Herausgeber in der Umsetzung des Konzepts.

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. *Inverse Problems in Differential Equations*. G. Anger, 1990-06-30. Elucidates the fundamental mathematical structures of inverse problems analyzing both the information content and the solution of some inverse problems in which the information content of the coefficients and the source term of a given differential equation is not too large. In order to be accessible.

Non-Linear Parametric Optimization

BANK, GUDDAT, KLATTE, KUMMER, TAMMER, 2013-12-21 **Radiating Nonuniform Transmission-Line Systems and the Partial Element Equivalent Circuit Method** Prof. Dr. Juergen Nitsch, Dr. Frank Gronwald, Prof. Dr. Gunter Wollenberg, 2009-10-29 High frequencies of densely packed modern electronic equipment turn even the smallest piece of wire into a transmission line with signal retardation dispersion attenuation and distortion In electromagnetic environments with high power microwave or ultra 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 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 **Linear Algebra and Analysis** Helmut Wielandt, 1996 Keine ausf hrliche Beschreibung f r Linear Algebra and Analysis verf gbar

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