

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

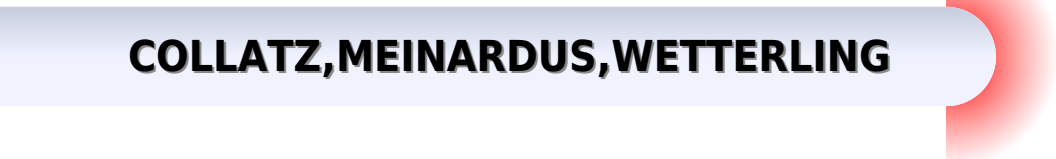
$$L = \begin{pmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 7 & 9 & 11 \end{pmatrix} \in \mathbb{R}^{3 \times 3}$$

mit

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

Numerische Methoden 1

COLLATZ, MEINARDUS, WETTERLING



Numerische Methoden 1:

Numerical Methods of Approximation Theory, Vol.6 \ Numerische Methoden der Approximationstheorie, Band 6
Collatz, Meinardus, Werner, 2012-12-06 Der Band enthält Manuskripte zu Vorträgen die auf einer von den Herausgebern geleiteten Tagung über Numerische Methoden der Approximationstheorie am Mathematischen Forschungsinstitut Oberwolfach in der Zeit vom 18. 24. Januar 1981 gehalten wurden. Das Spektrum der Vorträge reichte von der klassischen Approximationstheorie über mehrdimensionale Approximationsverfahren bis hin zu praxisbezogenen Fragestellungen. Zu den zuerst genannten Gebieten gehörten z. B. die Verfeinerung von Fehlerabschätzungen bei der Polynominterpolation, Fragen zur Eindeutigkeit, Charakterisierung optimaler Interpolationsprozesse und Algorithmen zur rationalen Interpolation. Bei den weiteren genannten Gebieten spiegeln zahlreiche Vorträge das steigende Interesse an der mehrdimensionalen Interpolation insbesondere mit verschiedenen Arten von Splines wider. Hier standen u. a. Probleme der Parameterschätzung in der Medizin und Flugtechnik, Fragen der Approximationstheorie bei der Konstruktion von Plottern und stabile Algorithmen beim Arbeiten mit mehrdimensionalen B-Splines im Mittelpunkt des Interesses. Die Tagung lieferte einen repräsentativen Überblick über die aktuellen Trends in der Approximationstheorie. Zum guten Erfolg der Tagung trug wie immer die hervorragende Betreuung durch die Mitarbeiter und Angestellten des Instituts so wie das verständnisvolle Entgegenkommen des Institutsdirektors Herrn Professor Dr. Barner bei. Unser besonderer Dank gilt dem Birkhäuser Verlag für die wie stets sehr gute Ausstattung. Helmut Werner, Lothar Collatz, Günther Meinardus, Hamburg, Mannheim, Bonn.

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Numerische Methoden der Approximationstheorie/Numerical Methods of Approximation Theory Meinardus, Collatz, Werner, 2013-11-11 Der vorliegende Band stellt Vortragsmanuskripte einer am Mathematischen Forschungsinstitut Oberwolfach in der Zeit vom 25. bis 31. Mai 1975 veranstalteten Tagung zusammen, die unter der Leitung der Unterzeichner stand. Die letzten dieser Tagungen über numerische Methoden der Approximationstheorie fanden 1971 und 1973 statt, der Schwerpunkt lag bei Fragen der Numerik von Algorithmen zur Darstellung von Funktionen, ließen aber bereits ein wachsendes Interesse an Anwendungen erkennen. Die diesjährige Tagung war gekennzeichnet durch die Behandlung praktischer Aufgabenstellungen sowie durch die Einbeziehung der Anwendungen aus Nachbargebieten bzw. die Verwendung der Methoden dieser Gebiete in der Approximationstheorie, insbesondere wurde auch auf die Beziehungen von Optimierung und Kontrolltheorie zu speziellen approximationstheoretischen Aufgaben eingegangen. Der starke Einfluss auf die numerischen Methoden zur Behandlung von Differentialgleichungen wurde etwa bei der Methode der finiten Elemente oder bei Kollokationsaufgaben deutlich. So ist zu hoffen, daß auch diese Tagung dazu beigetragen hat, Theorie und Anwendungen wieder stärker zu verbinden. Die spezifische

Atmosphäre des Forschungsinstituts stimulierte einen intensiven durch die breite internationale Streuung der Tagungsteilnehmer verstärkten fruchtbaren Gedankenaustausch Zum Erfolg der Tagung trug wie immer die hervorragende Betreuung durch die Mitarbeiter und Angestellten des Forschungsinstituts und das verstärkteste Entgegenkommen von Herrn Kollege Barner bei Unser besonderer Dank gilt ferner dem Birkhäuser Verlag für die sehr gute Ausstattung des Buches

L COLLATZ G MEINARDUS H WERNER Inhaltsverzeichnis ANSELONE P M LEE J W Double Approximation Methods for the Solution of Fredholm Integral Equations **Numerische Methoden bei Optimierungsaufgaben: Optimierung bei graphentheoretischen und ganzzahligen Problemen** Lothar Collatz, Wolfgang W. E. Wetterling, 1977 **Numerische Methoden bei graphentheoretischen und kombinatorischen Problemen** Lothar Collatz, 1975 **Numerische Methoden Der Approximationstheorie**, 1979 Selections from papers presented at the Tagung über Numerische Methoden der Approximationstheorie **Numerische Methoden der Approximationstheorie** Lothar Collatz, Günther Meinardus, 1972 **Numerische Methoden bei graphentheoretischen und kombinatorischen Problemen** COLLATZ, MEINARDUS, WETTERLING, 2013-11-21 **Numerische Methoden bei Optimierungsaufgaben** L. Collatz, W. Wetterling, 2013-11-21 *Numerische Methoden der Approximationstheorie* COLLATZ, MEINARDUS, WERNER, 2013-11-21

Numerische Methoden bei Optimierungsaufgaben COLLATZ, WETTERLING, 2013-11-22 Am Mathematischen Forschungsinstitut Oberwolfach fand in der Zeit vom 18 bis 24 November 1973 eine Tagung über Numerische Methoden bei Optimierungsaufgaben unter der Leitung der Unterzeichneten statt auf der naturgemäß die Fortschritte gegenüber den 1967 1969 und 1971 durchgeführten Tagungen mit gleichem Titel im Vordergrund des Interesses standen Auf dieser Tagung über Optimierungsaufgaben wurde die Anwendungsbezogenheit des Gebietes wieder besonders deutlich Im Mittelpunkt stand eine Reihe von Vorträgen über nichtlineare Optimierungsaufgaben Es konnten aber Fortschritte sowohl bei der praktischen Erprobung der Verfahren als auch bei ihrer theoretischen Begründung berichtet werden Trotzdem blieben noch manche Fragen offen Ein weiterer Schwerpunkt war die numerische Behandlung von Problemen der optimalen Steuerung Besonderen Anklang fanden auch eine Reihe von Vorträgen über Probleme aus den Anwendungsgebieten Zum Gelingen der Tagung trug nicht zuletzt die ausgezeichnete Betreuung durch das Personal des Instituts und das für diese Jahreszeit ungewöhnlich schöne Wetter bei Ferner sei der beste Dank dem Leiter des Mathematischen Forschungsinstituts Oberwolfach Herrn Professor Dr M Barner und dem Birkhäuser Verlag ausgesprochen Inhaltsverzeichnis Vorwort 5 B R DAMSTE Wageningen Minimalisierung durch Anlegung eines Gradientenfeldes 9 B FLEISCHMANN Hamburg Eine Kombination des Branch and Bound Prinzips und der dynamischen Optimierung an einem Beispiel aus der Produktionsplanung 11 W F RSTER Southampton über die numerische Lösung nichtlinearer Optimierungsprobleme bei Vorhandensein gewisser Invarianzeigenschaften 13 1985 H. Heinrich, G. Schmid, 2022-02-07 No detailed description available for 1985 Numerische Methoden der Technischen Akustik Gerhard Müller, Michael Möser, 2017-08-03 Dieser Band der Reihe Fachwissen

Technische Akustik behandelt die am weitesten verbreiteten wellentheoretischen Verfahren der numerischen Akustik Die Randelementemethode die Finite Elemente Methode und die Ersatzstrahlermethode werden in den Kapiteln ausführlich behandelt Weitere Methoden wie z B Approximationen für hohe Frequenzen Verfahren der geometrischen Akustik oder die statistische Energieanalyse werden ebenfalls kurz angesprochen *Spectral Approximation of Linear Operators* Francoise Chatelin, 2011-05-26 Originally published New York Academic Press 1983 *Optimization. Volume 19, Number 6*, 2022-03-21 No detailed description available for OPTIMIZATION V 19 6 OPT E BOOK **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

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 **Pade Approximants** George Allen Baker, Peter Graves-Morris, 1996-01-26 The first edition of this book was reviewed in 1982 as the most extensive treatment of Pade approximants actually available This second edition has been thoroughly updated with a substantial new chapter on multiseries approximants Applications to statistical mechanics and critical phenomena are extensively covered and there are newly extended sections devoted to circuit design

matrix Pade approximation and computational methods This succinct and straightforward treatment will appeal to scientists engineers and mathematicians alike **Numerical Methods of Approximation Theory/Numerische Methoden der Approximationstheorie** COLLATZ,2013-11-21 *Non-Linear Parametric Optimization*

BANK,GUDDAT,KLATTE,KUMMER,TAMMER,2013-12-21 *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 1 4 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

This book delves into Numerische Methoden 1. Numerische Methoden 1 is an essential topic that must be grasped by everyone, ranging from students and scholars to the general public. The book will furnish comprehensive and in-depth insights into Numerische Methoden 1, encompassing both the fundamentals and more intricate discussions.

1. This book is structured into several chapters, namely:

- Chapter 1: Introduction to Numerische Methoden 1
- Chapter 2: Essential Elements of Numerische Methoden 1
- Chapter 3: Numerische Methoden 1 in Everyday Life
- Chapter 4: Numerische Methoden 1 in Specific Contexts
- Chapter 5: Conclusion

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