

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

Bertrand Braunschweig, Xavier Joulia

A red circular graphic with a gradient, appearing as a stylized arrow or a partial circle, located to the right of the authors' names.

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 verständnisvolle Entgegenkommen von Herrn Kollege Barner bei Unser besonderer Dank gilt ferner dem Birkhäuser Verlag für die sehr gute Ausstattung des Buches

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Numerische Methoden bei graphentheoretischen und kombinatorischen Problemen

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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

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