

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

L. Collatz, W. 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.

7 INDEX Blatt H P Strenge Eindeutigkeitskonstanten und Fehlerabschätzungen bei linearer Tschebyscheff Approximation 9 Bohmer K Polynom und Spline Interpolation Ein Farbfilm 26 Brannigan M A Multivariate Adaptive Data Fitting Algorithm 30 Brass H Zur numerischen Berechnung konjugierter Funktionen 43 Bultheel A

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

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