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Computer-Aided Analysis of Difference Schemes for Partial Differential Equations; Contents; Preface; 1 The Necessary Basics from the Stability Theory of Difference Schemes and Polynomials; 1.1 Preliminary Discussion of Stability and Approximation; 1.2 Computer Algebra Systems; 1.3 A Brief Review of the Contents of Chapters; 1.4 Stability, Approximation, and Convergence; 1.5 A Survey of Methods for the Stability Analysis of Difference Schemes; 1.5.1 Von Neumann Stability Analysis; 1.5.2 Differential Approximation Method; 1.5.3 Method of Frozen Coefficients
 1.6 Algebraic Criteria for Localization of Polynomial Zeros
 1.6.1 Similarity and Dimensional Considerations; 1.6.2 Lienard-Chipart Criterion; 1.6.3 Generalized Routh-Hurwitz Problem for the Characteristic Polynomial; 1.7 Determination of the Maximal Time Step from Stability Analysis Results; 1.7.1 The Use of the Least Squares Method; 1.7.2 A Method Based on the Requirement of a Constant Volume of a Cell of a Spatial Computing Mesh; 1.7.3 The Use of the Tables of the Coordinates of Points of Stability Region Boundaries; 1.8 On the Choice of Nondimensional Complexes; 1.9 Bibliographical Notes
 1.9.1 Historical Note on Stability Theories
 1.9.2 Application of Algebraic Criteria to Stability Analyses; 1.9.3 Use of Computer Algebra for the Automation of Certain Stages of the Stability Analyses; References; 2 Symbolic-Numerical Method for the Stability Investigation of Difference Schemes on a Computer; 2.1 General Structure of the Symbolic-Numerical Method; 2.2 The Case of Diagonalizable Amplification Matrices; 2.3 Scheme Checker; 2.4 Symbolic Stages of the Method; 2.5 Generation of a FORTRAN Program by Computer Algebra
 2.6 Computation of the Coordinates of Points of a Stability Region Boundary
 2.6.1 Use of the Bisection Method; 2.6.2 Automatic Determination of the Number of Spectral Grid Points; 2.7 Improved Accuracy of Numerical Results; 2.7.1 Scaling in the Routh Algorithm; 2.7.2 Scaling in the Routh-Hurwitz Algorithm; 2.8 Examples of Stability Analyses of Difference Schemes for Equations of Hyperbolic Type; 2.8.1 Two-Step Richtmyer's Form of the Lax-Wendroff Scheme; 2.8.2 MacCormack Scheme for the Two-Dimensional Advection Equation; 2.8.3 Jameson's Schemes
 2.9 Stability Analysis of the MacCormack Scheme for Two-Dimensional Euler Equations
 2.10 Stability Analysis of the MacCormack Scheme for Three-Dimensional Euler Equations; 2.11 Examples of Stability Analyses of Difference Schemes for Navier-Stokes Equations; 2.11.1 A Family of Schemes for One-Dimensional Navier-Stokes Equations; 2.11.2 Difference Schemes on Curvilinear Grids; References; 3 Application of Optimization Methods to the Stability Analysis of Difference Schemes; 3.1 Formulation of a Search for Stability Region Boundaries of Difference Schemes in Terms of Optimization Theory
 3.1.1 The Case of One Nondimensional Complex

Advances in computer technology have conveniently coincided with trends in numerical analysis toward increased complexity of computational algorithms based on finite difference methods. It is no longer feasible to perform stability investigation of these methods manually--and no longer necessary. As this book shows, modern computer algebra tools can be combined with methods from numerical analysis to generate programs that will do the job automatically. Comprehensive, timely, and accessible--this is the definitive reference on the application of computerized symbolic manipulations for a