《降阶法及其在偏微分方程数值解中》

图书基本信息

书名：《降阶法及其在偏微分方程数值解中的应用》

13位ISBN编号：9787030245465

10位ISBN编号：7030245466

出版时间：2009-6

出版社：科学出版社

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页数：415

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前言

The method of order reduction has been developed on the basis of the well-known Keller， s box scheme.It is an indirect method of constructing difference schemes for approximating the difierential equations.First， some new variables are introduced for the reduction of the original problem into an equivalent system of lower order differential equations and a difference scheme is constructed for the latter.Then， the discrete variables are separated to obtain a difference scheme only containing the original variables.The aim of introducing the new variables iS for the theoretical analysis of the difference scheme.The method iS applicable to numerical approxima- tions of the problems with derivative boundary conditions， mixed derivatives， dis- continuous coefficients or inner boundaries， and the problems of high nonlinearity as well as the high coupled systems， etc.Now this method has been successfully applied to the numerical solutions for linear parabolic equations， linear hyperbolic equations， linear elliptic equations， heat equations with concentrated capacity， heat equations with nonlinear boundary conditions， nonlocal parabolic equations， diflusion-wave equations， wave equations with heat conduction， Timoshenko beam equations with boundary feedback， the Kuramoto-Tsuzuki equation ， thermoplastic problems， ther- moelastic problems， nonlinear parabolic systems， superthermal electron transport equations， oil deposit models， the Cahn-Hilliard equation， systems of parabolic and elliptic equations ， etc.The resulting difierence schemes usually have second order global accuracy in the maximum norm.Sometimes， with once extrapolation， the fourth order approximation in the maximum norm can be obtained.In addition， the ditie， rence scheme can be constructed on non-uniform grids which makes easy to refine the grids where the solution changes rapidly in order to reduce the amount of the computational work. The problems we consider include linear equations VS.nonlinear equations， lower order differential equations vs.higher order differential equations， one differential equation vs.the system of differential equations， local differential equations vs.non- local differential equations.one-dimensiohal problems vs。 multi-dimensiohal prob- lems.problems in the fixed domain VS.problems in the variable domain， problems with classical boundary conditions vs.problems with nonclassical boundary con- ditions.problems in the bounded domain VS.problems in the unbounded domain， differential equations of integer order vs.differential equations of fractional order， real differential equations vs.complex difierential equations.

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内容概要

《降阶法及其在偏微分方程数值解中的应用》讲述了：The layout of this book is as follows. Chapter 1 provides a microcosm of the method of order reduction via a two-point boundary value problem. Chapters 2, 3 and 4 are devoted, respectively, to the numerical solutions of linear parabolic, hyperbolic and elliptic equations by the method of order reduction. They are the core of the book. Chapters 5, 6 and 7 respectively consider the numerical approaches to the heat equation with an inner boundary condition, the heat equation with a nonlinear boundary condition and the nonlocal parabolic equation. Chapter 8 discusses the numerical approximation to a fractional diffusion-wave equation. The next five chapters are devoted to the numerical solutions of several coupled systems of differential equations. The numerical procedures for the heat equation and the Burgers equation in the unbounded domains are studied in Chapters 14, 15 and 16. Chapter 17 provides a numerical method for the superthermal electron transport equation, which is a degenerate and nonlocal evolutionary equation. The numerical solution to a model in oil deposit on a moving boundary is presented in Chapter 18. Chapter 19 deals with the numerical solution to the Cahn-Hilliard equation, which is a fourth order nonlinear evolutionary equation. The ADI and compact ADI methods for the multidimensional parabolic problems are discussed in Chapter 20. The numerical errors in the maximum norm are obtained. Chapter 21, the last chapter, is devoted to the numerical solution to the time-dependent SchrSdinger equation in quantum mechanics.

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