

Contents

Preface	vii
1 Introduction	1
2 Initial value problems for scalar conservation laws in 1-D	15
2.1 Theoretical background	15
2.2 Finite difference schemes of first order for scalar equations in one spatial dimension	39
2.3 Convergence of finite difference schemes of first order in 1-D .	53
2.4 Stability and consistency for linear initial value problems . . .	87
2.5 Finite difference schemes of higher order for scalar equations in one spatial dimension	98
2.6 Streamline diffusion method	117
3 Initial value problems for scalar conservation laws in 2-D	141
3.1 Dimensional splitting schemes for scalar conservation laws in 2-D	141
3.2 Finite volume schemes in 2-D	155
3.3 Convergence of finite volume schemes in 2-D on unstructured grids	164
3.4 Error estimates for first-order schemes	191
3.5 Higher-order finite volume schemes for scalar equations . . .	212
3.6 Proof of convergence of higher-order finite volume schemes for scalar equations	225
3.7 Essentially non-oscillatory schemes	238

3.8	Fluctuation splitting schemes	254
3.9	Adaptivity and local grid alignment: numerical experiments .	258
4	Initial value problems for systems in 1-D	276
4.1	Basic results for systems in 1-D	276
4.2	Chorin's method for solving the Riemann problem for systems	319
4.3	The basis of Glimm's existence proof for systems in 1-D . . .	325
4.4	Numerical schemes for hyperbolic systems in 1-D	333
4.5	The Osher–Solomon scheme	355
5	Initial value problems for systems of conservation laws in 2-D	372
5.1	Finite volume methods for systems in several space dimensions	372
5.2	The discretization matrices for systems in two and three spatial dimensions	384
5.3	Numerical examples for the Euler equations of gas dynamics .	394
6	Initial boundary value problems for conservation laws	422
6.1	Boundary conditions for linear systems	422
6.2	Boundary conditions for nonlinear scalar equations	437
7	Convection-dominated problems	456
7.1	Singular perturbation problems for elliptic equations	456
7.2	Discretization of the compressible Navier–Stokes equations . .	473
	List of figures	479
	References	482
	Index	503