

Contents

Chapter 1. General Introduction

1.1	Introduction	1
1.2	Boundary Value Problems and Initial Value Problems . . .	4
1.3	One Dimensional Unsteady Flow Characteristics	6
1.4	Steady Supersonic Plane or Axi-Symmetric Flow. Equations of Motion in Characteristic Form	9
1.5	Basic Concepts Used in Finite Difference Methods	15
	References	27

Chapter 2. The Godunov Schemes

2.1	The Origins of Godunov's First Scheme	28
2.2	Godunov's First Scheme. One Dimensional Eulerian Equations	33
2.3	Godunov's First Scheme in Two and More Dimensions . . .	39
2.4	Godunov's Second Scheme	41
2.5	The Double Sweep Method	46
2.6	Execution of the Second Scheme on the Intermediate Layer	48
2.7	Boundary Conditions on the Intermediate Layer	50
2.8	Procedure on the Final Layer	52
2.9	Applications of the Second Godunov Scheme	53
	References	56

Chapter 3. The BVLR Method

3.1	Description of Method for Supersonic Flow	57
3.2	Extensions to Mixed Subsonic-Supersonic Flow. The Blunt Body Problem	63
3.3	The Double Sweep Method for Unsteady Three-Dimensional Flow	67
3.4	Worked Problem. Application to Circular Arc Airfoil. . . .	69
3.5	Results and Discussion	76
	References	79

Chapter 4. The Method of Characteristics for Three-Dimensional Problems in Gas Dynamics

4.1	Introduction	80
4.2	Bicharacteristics Method (BUTLER)	83
4.3	Optimal Characteristics Methods (BRUHN and HAACK, SCHAETZ)	90
4.4	Near Characteristics Method (SAUER)	95
	References	103

Chapter 5. The Method of Integral Relations

5.1	Introduction	104
5.2	General Formulation. Model Problem	106
5.3	Flow Past Ellipses	110
5.4	The Supersonic Blunt Body Problem	112
5.5	Transonic Flow	116
5.6	Incompressible Laminar Boundary Layer Equations. Basic Formulation	121
5.7	The Method in the Compressible Case	127
5.8	Laminar Boundary-Layers with Suction or Injection	136
5.9	Extension to Separated Flows	139
5.10	Application to Supersonic Wakes and Base Flows	146
5.11	Application to Three-Dimensional Laminar Boundary Layers	149
5.12	A Modified Form of the Method of Integral Relations	160
5.13	Application to Viscous Supersonic Conical Flows	164
5.14	Extension to Unsteady Laminar Boundary Layers	168
	Model Problem (CHU and GONG)	172
	References	175

Chapter 6. Telenin's Method and the Method of Lines

6.1	Introduction	178
6.2	Solution of Laplace's Equation by Telenin's Method	179
6.3	Solution of a Model Mixed Type Equation by Telenin's Method	182
6.4	Application of Telenin's Method to the Symmetrical Blunt Body Problem	188
6.5	Extension to Unsymmetrical Blunt Body Flows	194
6.6	Application of Telenin's Method to the Supersonic Yawed Cone Problem	200
6.7	The Method of Lines. General Description	212
6.8	Applications of the Method of Lines	216
6.9	Powell's Method Applied to Two Point Boundary Value Problems	228
	Telenin's Method. Model Problems	233
	References	247

Subject Index	249
--------------------------------	------------

