



# Contents

Preface . . . . .	v
Chapter 1. An Overview of Semidiscretization and Time Integration Procedures by Ted Belytschko . . . . .	1
Introduction . . . . .	2
1. Semidiscretizations of the diffusion equation . . . . .	3
2. Solid mechanics semidiscretization . . . . .	19
3. Time integration . . . . .	41
References . . . . .	63
Chapter 2. Analysis of Transient Algorithms with Particular Reference to Stability Behavior by Thomas J.R. Hughes . . . . .	67
A. Introduction . . . . .	68
B. Linear systems . . . . .	71
C. Nonlinear symmetric systems . . . . .	134
D. Nonsymmetric operators . . . . .	148
References . . . . .	153
Chapter 3. Partitioned Analysis of Coupled Systems by K.C. Park and C.A. Felippa . . . . .	157
1. Introduction . . . . .	158
2. Coupled systems . . . . .	161
3. Time discretization . . . . .	166
4. Partitioned analysis formulations . . . . .	172
5. Partitions . . . . .	174
6. Stability . . . . .	181
7. Accuracy . . . . .	186
8. A case study in stabilization . . . . .	198
9. Application examples . . . . .	212
10. Concluding remarks . . . . .	216
References . . . . .	218
Chapter 4. Boundary-Element Methods for Transient Response Analysis by Thomas L. Geers . . . . .	221
1. Introduction . . . . .	222
2. BEM in three dimensions . . . . .	225
3. BEM solutions . . . . .	233
4. Conclusion . . . . .	239
References . . . . .	240

<b>Chapter</b>	<b>5. Dynamic Relaxation</b>	
	<i>by Philip Underwood</i>	245
1.	Introduction	246
2.	Development	246
3.	An adaptive DR method	256
4.	Numerical examples	258
5.	Remarks	262
	References	263
<b>Chapter</b>	<b>6. Dispersion of Semidiscretized and Fully Discretized Systems</b>	
	<i>by Howard L. Schreyer</i>	267
1.	Introduction	268
2.	Dispersion associated with temporal discretization	272
3.	Dispersion associated with spatial discretization	278
4.	Dispersion associated with complete discretization	291
5.	Conclusion	297
	References	298
<b>Chapter</b>	<b>7. Silent Boundary Methods for Transient Analysis</b>	
	<i>by Martin Cohen and Paul C. Jennings</i>	301
1.	Introduction and review of literature	302
2.	Theory of paraxial viscous silent boundaries	309
3.	Implementation	329
4.	Numerical procedures and results	333
5.	Concluding remarks	354
	References	357
<b>Chapter</b>	<b>8. Explicit Lagrangian Finite-Difference Methods</b>	
	<i>by W. Herrmann and L.D. Bertholf</i>	361
1.	Introduction	362
2.	Conservation laws	363
3.	Constitutive equations	365
4.	Differential equations	372
5.	Difference equations	374
6.	Gradient approximations	379
7.	Stress gradients; momentum	381
8.	Velocity gradients; mass conservation	384
9.	Artificial viscosity and damping	386
10.	Boundaries and interfaces	392
11.	Rezoning	400
	Glossary	411
	Appendix	412
	References	413
<b>Chapter</b>	<b>9. Implicit Finite Element Methods</b>	
	<i>by M. Geradin, M. Hogge and S. Idelsohn</i>	417
1.	General aspects of implicit time integration	418
2.	Different classes of implicit time operators	422
3.	Particular aspects of nonlinear implicit integration	431
4.	Computer implementation of an implicit finite element code for transient analysis	445
5.	Sample problems	453
	References	470

<b>Chapter 10. Arbitrary Lagrangian–Eulerian Finite Element Methods by Jean Donea</b>	473
1. Introduction	474
2. The arbitrary Lagrangian–Eulerian formulation	475
3. Spatially discrete models	483
4. Explicit time integration	492
5. Automatic rezoning	495
6. Fluid-structure coupling	503
Conclusion	514
References	514
<b>Author Index</b>	517
<b>Subject Index</b>	520