## Contents

	Preface Notations	ix xi
I	Introduction	I
1.1	Overview of river engineering	1
1.2	Role of computational simulation in river engineering analysis	3
1.3	Scope, problems, and strategies of computational river dynamics	4
1.4	Classification of flow and sediment transport models	7
1.5	Coverage and features of this book	9
2	Mathematical description of flow and sediment	
	transport	11
2.1	-	11
2.1 2.2	transport	
	transport Properties of water and sediment	11
2.2	transport Properties of water and sediment Governing equations of water and sediment two-phase flow Time-averaged models of turbulent flow and sediment transport	11 20
2.2 2.3	transport Properties of water and sediment Governing equations of water and sediment two-phase flow Time-averaged models of turbulent flow and sediment transport Derivation of 1-D and 2-D flow and sediment transport	11 20 23
<ul><li>2.2</li><li>2.3</li><li>2.4</li></ul>	transport Properties of water and sediment Governing equations of water and sediment two-phase flow Time-averaged models of turbulent flow and sediment transport Derivation of 1-D and 2-D flow and sediment transport equations	11 20 23 29

3 F	undamentals of sediment transport	59
3.1	Settling of sediment particles	59
3.2	Incipient motion of sediment	67
3.3	Movable bed roughness in alluvial rivers	75
3.4	Bed-load transport	81
3.5	Suspended-load transport	91
3.6	Bed-material load transport	99
3.7	Sediment transport over steep slopes	107
3.8	Temporal lags between flow and sediment transport	110
4	Numerical methods	3
4.1	Concepts of numerical solution	113
4.2	Finite difference method	118
4.3	Finite volume method	141
4.4	Numerical solution of Navier-Stokes equations	156
4.5	Solution of algebraic equations	168
5	I-D numerical models	175
5.1	Formulation of 1-D decoupled flow and sediment transport model	175
5.2	1-D calculation of open-channel flow	188
5.3	1-D calculation of sediment transport	208
5.4	1-D coupled calculation of flow and sediment transport	225
5.5	Data requirements of 1-D model	232
5.6	Model sensitivity to input parameters	234
6	2-D numerical models	241
6.1	Depth-averaged 2-D simulation of flow in nearly straight channels	241
6.2	Depth-averaged 2-D simulation of sediment transport in nearly straight channels	257

		Contents vii
6.3	Depth-averaged 2-D simulation of flow and sediment transport in curved and meandering channels	269
6.4	Width-averaged 2-D model of flow and sediment transport	280
7 3	3-D numerical models	289
7.1	Full 3-D hydrodynamic model	289
7.2	3-D flow model with hydrostatic pressure assumption	296
7.3	3-D sediment transport model	302
7.4	3-D simulation of local scour around in-stream structures	312
8 1	Domain decomposition and model integration	323
8.1	Multiblock method	323
8.2	Coupling of 1-D, 2-D, and 3-D models	333
8.3	Integration of channel and watershed models	339
9 9	Simulation of dam-break fluvial processes	347
9.1	Simulation of dam-break flow over fixed beds	347
9.2	Simulation of dam-break flow over movable beds	363
9.3	Simulation of dam surface erosion due to overtopping flow	370
10	Simulation of flow and sediment transport in vegetated channels	375
10.1	Effects of vegetation on flow and sediment transport	375
10.2	Simulation of flow in vegetated channels	389
10.3	Simulation of sediment transport in vegetated channels	397
11	Cohesive sediment transport modeling	403
11.1	Cohesive sediment transport processes	403
11.2	Multiple-floc-size model of cohesive sediment transport	417
11.3	Single-floc-size model of cohesive sediment transport	419
11.4	Simulation of transport of cohesive and non-cohesive sediment mixtures	426

12	Contaminant transport modeling	429
12.1	Heat and salinity transport model	429
12.2	Water quality model	439
12.3	Simulation of sediment-borne contaminant transport	455
	References Index	465 489