

# Table of Contents

<b>Preface</b>	<b>V</b>
<b>I Social Science Microsimulation / Microanalytic Simulation Models</b>	<b>1</b>
<b>1 A Comparison of a 4GL and an Object-oriented Approach in Micro Macro Simulation</b>	<b>3</b>
<i>by Hans-Dieter Heike, Kai Beckmann, Achim Kaufmann, Harald Ritz, and Thomas Sauerbier</i>	
1.1 Introduction . . . . .	3
1.2 Darmstadt Micro Macro Simulator . . . . .	4
1.3 Fourth Generation Language System . . . . .	11
1.4 Application Development Tools . . . . .	15
1.5 Object-oriented System . . . . .	24
1.6 Concluding Remarks . . . . .	30
<b>2 MICSIM: Concept, Developments, and Applications of a PC Microsimulation Model for Research and Teaching</b>	<b>33</b>
<i>by Joachim Merz</i>	
2.1 Microsimulation for Research and Teaching . . . . .	33
2.2 Microsimulation — General Characteristics and Requirements	34
2.3 MICSIM – Concept and Substantive Modules . . . . .	40
2.4 MICSIM – Realisations and Developments . . . . .	50
2.5 MICSIM – Applications . . . . .	59
2.6 Concluding Remarks . . . . .	62
<b>3 Exploring and Testing Theories: On the Role of Parameter Opti- mization in Social Science Computer Simulation</b>	<b>66</b>
<i>by Georg Müller</i>	
3.1 Simulation Assisted Theory Building . . . . .	66

3.2	On the Role of Parameter Optimization in Simulation Assisted Theory Building . . . . .	68
3.3	An Example: Exploring and Testing Richardson's Theory of Arms Races . . . . .	70
3.4	Software Requirements for Parameter Optimization . . . . .	74
3.5	Summary and Outlook . . . . .	75
<b>4</b>	<b>Why Are We Simulating Anyway? Some Answers from Economics</b> <b>78</b>	
	<i>by Edmund Chattoe</i>	
4.1	Simulating What? . . . . .	78
4.2	Different But Equal Representations of Theory . . . . .	82
4.3	Difficulties with Mathematical Representation . . . . .	87
4.4	The Possibilities of Simulation . . . . .	93
4.5	But Is It Science? . . . . .	96
4.6	Conclusion . . . . .	102
<b>II</b>	<b>Social Science Multilevel Simulation</b>	<b>105</b>
<b>5</b>	<b>Multilevel Simulation</b>	<b>107</b>
	<i>by Klaus G. Troitzsch</i>	
5.1	Introduction . . . . .	107
5.2	Modeling Approaches . . . . .	108
5.3	Opinion Formation in a Homogeneous Population . . . . .	112
5.4	Attitude Formation in a Homogeneous Population . . . . .	113
5.5	Gender Desegregation . . . . .	115
5.6	Interactions in Small Groups . . . . .	117
5.7	Conclusion . . . . .	120
<b>6</b>	<b>Social Science Multilevel Simulation with MIMOSE</b>	<b>123</b>
	<i>by Michael Möhring</i>	
6.1	Modelling in MIMOSE . . . . .	123
6.2	Experimentation with Models . . . . .	131
6.3	Conclusions . . . . .	136
<b>7</b>	<b>Multilevel Modelling with MIMOSE:</b>	
	<b>Experience from a Social Science Application</b>	<b>138</b>
	<i>by Nicole J. Saam</i>	
7.1	The Problem: Military Intervention in Politics . . . . .	138
7.2	The Formal Approach to Multilevel Modeling . . . . .	139
7.3	The Multilevel Model of Military Intervention in Politics . . . . .	140
7.4	The Application: Military Intervention in Thailand . . . . .	144
7.5	Results . . . . .	144

7.6	Sensitivity Analysis . . . . .	148
7.7	Research Questions . . . . .	153
<b>8</b>	<b>A Microsimulation Tool for Social Force Models</b>	<b>155</b>
	<i>by Péter Molnár</i>	
8.1	Simulation of Pedestrian Traffic . . . . .	155
8.2	The Simulation Program . . . . .	164
8.3	Summary and Outlook . . . . .	168
<b>9</b>	<b>Evolution in Humans of Macro-level Social Stratification and Language</b>	<b>171</b>
	<i>by Allan Mazur</i>	
9.1	Introduction . . . . .	171
9.2	Modeling Social Stratification . . . . .	172
9.3	Modeling Human Language . . . . .	174
9.4	Conclusion . . . . .	176
<b>10</b>	<b>Survival Analysis, Master Equation, Efficient Simulation of Path-Related Quantities, and Hidden State Concept of Transitions</b>	<b>179</b>
	<i>by Dirk Helbing</i>	
10.1	Introduction . . . . .	179
10.2	Survival Analysis . . . . .	180
10.3	The Master Equation Technique . . . . .	184
10.4	Simulation of Path-Related Quantities . . . . .	188
10.5	Occurrence Probabilities and Occurrence Times of Paths . . . . .	190
10.6	Effective Cumulative Life-Time Distribution and Hidden State Concept . . . . .	194
10.7	Summary and Outlook . . . . .	205
<b>III</b>	<b>Game Theory and Cellular Automata</b>	<b>209</b>
<b>11</b>	<b>Game Theory, Decision Making in Conflicts and Computer Simulations: a Good-Looking Triad</b>	<b>211</b>
	<i>by Wim B.G. Liebrand and David M. Messick</i>	
11.1	Introduction . . . . .	211
11.2	Game Theory . . . . .	212
11.3	Decision Making under Uncertainty and Conflict . . . . .	214
11.4	Social Dilemmas . . . . .	215
11.5	A Model of Decision Making in Social Dilemmas . . . . .	216
11.6	The Simulation Environment . . . . .	217
11.7	Basic Findings of the Simulations . . . . .	219
11.8	Small Groups versus Large Groups . . . . .	221

11.9 Cooperation in Large Groups. . . . .	223
11.10 Theoretical Model . . . . .	227
11.11 Summary and Conclusions . . . . .	233
<b>12 From Life Event Analysis to Life Course Analysis</b>	<b>237</b>
<i>by Ulrich Mueller</i>	
12.1 Introduction . . . . .	237
12.2 From Transition Rate Models to Evolutionary Life History Analysis . . . . .	239
12.3 Stochastic Dynamic Programming in Life Course Analysis: Basic Concepts and a Simple Model . . . . .	249
12.4 Testing the New Models Against Real Data. . . . .	260
<b>13 Simulating Cooperation and Competition: Present State and Future Objectives</b>	<b>264</b>
<i>by Ramzi Suleiman</i>	
13.1 Introduction . . . . .	264
13.2 Collective Stability in Heterogeneous Populations . . . . .	267
13.3 Changing the Strategic Objective . . . . .	269
13.4 Introducing Space . . . . .	271
13.5 Towards the Simulation of Social Dilemmas . . . . .	272
13.6 Towards the Simulation of Intergroup Conflict . . . . .	274
13.7 Concluding Remarks . . . . .	276
<b>14 Understanding Social Dynamics: The Cellular Automata Approach</b>	<b>282</b>
<i>by Rainer Hegselmann</i>	
14.1 Introduction . . . . .	282
14.2 CA and Social Dynamics . . . . .	283
14.3 A Short History of CA Based Modeling in the Social Sciences	287
14.4 A Migration Model: Evolution of Support Networks . . . . .	291
14.5 Why CA based modeling and simulations? . . . . .	302
<b>15 Spatial Evolution of Automata in the Prisoner's Dilemma</b>	<b>307</b>
<i>by Oliver Kirchkamp</i>	
15.1 Introduction . . . . .	307
15.2 The Model . . . . .	315
15.3 Results with Fixed Learning Rules . . . . .	327
15.4 Conclusions . . . . .	353
15.5 Proof of Proposition 15.1 . . . . .	355

**16 Simulating the Social Context of Human Choice** **359**  
*by Matthew J. Rockloff and Bibb Latané*

16.1 Introduction . . . . . 359  
16.2 Social Impact Theory . . . . . 360  
16.3 Dynamic Social Impact . . . . . 361  
16.4 Theory and Data . . . . . 364  
16.5 Demonstrating Dynamic Social Impact . . . . . 365  
16.6 SITSIM: Predicting the Emergence of Organization . . . . . 369  
16.7 GroupSim: Tailored to the Task . . . . . 370  
16.8 Discussion . . . . . 374  
16.9 Conclusion . . . . . 375

**IV Distributed Artificial Intelligence** **379**

**17 Simulating Societies using Distributed Artificial Intelligence** **381**  
*by Jim Doran*

17.1 Introduction . . . . . 381  
17.2 Modelling & Simulation . . . . . 381  
17.3 Distributed AI . . . . . 383  
17.4 Agent Designs . . . . . 383  
17.5 Sets of Intelligent Agents . . . . . 386  
17.6 Using DAI to Simulate Societies . . . . . 386  
17.7 Illustrative Examples . . . . . 387  
17.8 Prospects and Problems . . . . . 391  
17.9 Acknowledgments . . . . . 391

**18 Simulating Multi-Agent Interdependencies.**  
**A Two-Way Approach to the Micro-Macro Link** **394**  
*by Rosaria Conte and Cristiano Castelfranchi*

18.1 Some Requirements for Social Theory . . . . . 394  
18.2 The Dependence Theory . . . . . 399  
18.3 The DEPNET Simulator . . . . . 405  
18.4 The Potentialities of DEPNET . . . . . 406  
18.5 Conclusive Remarks . . . . . 412

**19 Artificial Intelligence Modelling: Data Driven and Theory Driven Approaches** **416**  
*by Klaus Manhart*

19.1 Three Dilemmas of Conventional Computer Models . . . . . 416  
19.2 AI Based Modelling . . . . . 417  
19.3 Theory Driven AI-Modelling . . . . . 420

19.4	Data Driven AI-Modelling . . . . .	422
19.5	A Mixed Approach: Discovery of Theoretical Explanations for Group Processes . . . . .	424
19.6	Conclusion . . . . .	429
<b>20</b>	<b>Object-Oriented and Agent-Oriented Simulation: Implications for Social Science Application</b>	<b>432</b>
	<i>by Adelinde Uhrmacher</i>	
20.1	Introduction . . . . .	433
20.2	Agents: Deliberative, Situated, Reactive, Rational .... . . . .	434
20.3	The Object-Oriented Simulation System DEVS . . . . .	435
20.4	DEVS and Agent-Oriented Techniques . . . . .	437
20.5	A Step to Agent-Oriented Simulation — AgedDEVS . . . . .	438
20.6	Hiring and Firing . . . . .	439
20.7	AgedDEVS and Agent-Oriented Simulation . . . . .	444
20.8	Conclusions . . . . .	445
<b>21</b>	<b>Simulation as a Research Strategy</b>	<b>448</b>
	<i>by G. Nigel Gilbert</i>	
21.1	The Advantages of Simulation . . . . .	448
21.2	A Methodology for Simulation Research . . . . .	450
21.3	Some Conjectures Arising from the Simulations . . . . .	452
21.4	Computing Techniques and Tools for Simulation . . . . .	453
<b>V</b>	<b>Appendix</b>	<b>455</b>
<b>A</b>	<b>Environments and Languages to Support Social Simulation</b>	<b>457</b>
	<i>Summary of an Informal Discussion by G. Nigel Gilbert</i>	
<b>B</b>	<b>Computer Simulation and Social Sciences: On the Future of a Dif- ficult Relation</b>	<b>459</b>
	<i>Summary of an Informal Discussion by Klaus G. Troitzsch</i>	
	<b>Author Index</b>	<b>461</b>
	<b>Subject Index</b>	<b>469</b>