

# Contents

## Preface

<b>1</b>	<b>GeoComputational Modelling - Techniques and Applications:</b>	1
	<b>Prologue</b>	
	<i>Manfred M. Fischer and Yee Leung</i>	

## PART A: Concepts, Modelling Tools and Key Issues

<b>2</b>	<b>Computational Neural Networks - Tools for Spatial Data Analysis</b>	
	<i>Manfred M. Fischer</i>	
2.1	Introduction	15
2.2	Why Computational Neural Networks?	17
2.3	Definition of a Computational Neural Network	20
2.4	Properties of the Processing Elements	21
2.5	Network Topologies	24
2.6	Learning in a Computational Neural Network	27
2.7	A Taxonomy of Computational Neural Networks	29
2.8	Outlook – How Do Neurocomputing Techniques Differ?	34
<b>3</b>	<b>Evolving Computational Neural Networks Through Evolutionary Computation</b>	
	<i>Xin Yao</i>	
3.1	Introduction	35
3.2	Evolving Computational Neural Network Architectures	37
3.3	EPNet	40
3.4	Experimental Studies	48
3.5	Evolutionary Learning and Optimization	60
3.6	A Population of ECNNs as an Ensemble	61
3.7	Conclusions	69

**4 Neural and Evolutionary Computation Methods for Spatial Classification and Knowledge Acquisition***Yee Leung*

4.1	Introduction	71
4.2	Spatial Classification by Multilayer Feedforward Neural Networks	73
4.3	Spatial Classification by Other Unidirectional Neural Networks	78
4.4	Spatial Classification by Recurrent Neural Networks	80
4.5	Clustering by Scale-Space Algorithms	80
4.6	Rule Learning by a Radial Basis Function Neural Network	83
4.7	Rule Learning by a Hybrid Fuzzy Neural Network	89
4.8	Rule Acquisition by Genetic Algorithms – The SCION System	94
4.9	Fuzzy Rule Acquisition by Genetic Algorithms –The GANGO System	100
4.10	Conclusions	107

**5 Cellular Dynamics: Modelling Urban Growth as a Spatial Epidemic***Michael Batty*

5.1	Defining Urban Growth as Sprawl	109
5.2	Growth as an Epidemic: Spatially Aggregate Models	112
5.3	Simplifications and Extensions to the Aggregate Model	116
5.4	Growth as Spatial Diffusion: Spatially Disaggregate Models	122
5.5	A Computable Structure Based on Cellular Automata	125
5.6	The Dynamics of Urban Regeneration	130
5.7	Classifying Urban Growth through Morphology	134
5.8	Conclusions: Applications and Policy	139

**PART B: Spatial Application Domains****6 Spatial Pattern Recognition in Remote Sensing by Neural Networks***Graeme Wilkinson*

6.1	Introduction	145
6.2	Artificial and Biological Neural Networks	146
6.3	Recent Developments in Remote Sensing	147
6.4	Uses of Neural Networks in Remote Sensing	148
6.5	Creation of Neural Network Input Vectors	150

6.6	Neural Networks in Unsupervised Classification of Remote Sensing Data	150
6.7	Neural Networks in Supervised Classification of Remote Sensing Data	154
6.8	'Soft Computing' Approaches Using Neural Networks	157
6.9	Managing Complexity	159
6.10	Hybrid Analysis Methodologies	162
6.11	Conclusions	164
<b>7</b>	<b>Fuzzy ARTMAP - A Neural Classifier for Multispectral Image Classification</b>	
	<i>Sucharita Gopal and Manfred M. Fischer</i>	
7.1	Introduction	165
7.2	Adaptive Resonance Theory and ART 1	166
7.3	The ARTMAP Neural Network Architecture	173
7.4	Generalization to Fuzzy ARTMAP	177
7.5	The Spectral Pattern Recognition Problem	180
7.6	Fuzzy ARTMAP Simulations and Classification Results	181
7.7	Summary and Conclusions	188
<b>8</b>	<b>Neural Spatial Interaction Models</b>	
	<i>Manfred M. Fischer</i>	
8.1	Introduction	195
8.2	The Model Class under Consideration	196
8.3	Training Neural Spatial Interaction Models: Classical Techniques	200
8.4	A New Global Search Approach for Network Training: The Differential Evolution Model	205
8.5	Selecting Neural Spatial Interaction Models: The Model Choice Issue	208
8.6	Evaluating the Generalization Performance of a Neural Spatial Interaction Model	214
8.7	Conclusion and Outlook	218

**9 A Neural Network Approach for Mobility Panel Analysis**  
*Günter Haag*

9.1	Introduction	220
9.2	The German Mobility Panel	221
9.3	Classical Panel Analysis	223
9.4	Application of Computational Neural Networks to the German Mobility Panel	223
9.5	Analysis of the Variable LOG[DAU_SUM]	228
9.6	Analysis of the Variable NUTZPKW	232
9.7	Conclusions and Outlook	234
<b>References</b>		237
<b>List of Figures</b>		257
<b>List of Tables</b>		259
<b>Subject Index</b>		261
<b>Author Index</b>		271
<b>List of Contributors</b>		277