

Contents

1	Introduction to Intelligence Techniques in Environmental Management	1
	Cengiz Kahraman and İrem Uçal Sarı	
1.1	Introduction	1
1.2	Environmental Management	2
1.2.1	Carbon Management	3
1.2.2	Soil Degradation and Management	3
1.2.3	Disaster Response and Management	4
1.2.4	Solid Waste Management	4
1.2.5	Wastewater Management	5
1.2.6	Water Resources Management	5
1.2.7	Sustainable Transportation	6
1.2.8	Hazardous Waste Management	6
1.2.9	Air Quality Management	6
1.2.10	Energy Management	7
1.3	Intelligent Systems Classification	7
1.3.1	Particle Swarm Optimization	8
1.3.2	Genetic Algorithms	8
1.3.3	Fuzzy Sets	8
1.3.4	Ant Colony Optimization	9
1.3.5	Bee Colony Optimization	9
1.3.6	Neural Networks	9
1.3.7	Simulated Annealing	10
1.3.8	Tabu Search	10
1.3.9	Swarm Intelligence	10
1.3.10	Differential Evolution	11
1.3.11	Evolutionary Algorithms	11
1.4	Literature Review	11
1.5	Future Trends	15
1.6	Conclusion	17
	References	17

Part I Waste Management

2	An Intuitionistic Fuzzy MCDM Approach for Effective Hazardous Waste Management	21
	Gülçin Büyüközkan and Fethullah Gocer	
2.1	Introduction	21
2.2	Literature Review	22
2.2.1	Hazardous Waste Management	22
2.2.2	IF TOPSIS Literature.	23
2.3	IF TOPSIS Methodology	24
2.3.1	Intuitionistic Fuzzy Sets	24
2.3.2	Proposed Computational Steps	25
2.4	Case Study	30
2.4.1	Company Background	30
2.4.2	Implementation of the Proposed Methodology	31
2.5	Conclusion	38
	References.	38
3	Intelligent Optimization of Wastewater Collection Networks	41
	Ali Haghighi	
3.1	Introduction	41
3.2	Sewer Layout Design	43
3.2.1	Basic Graph Theory	43
3.2.2	Sewer Layout Constraints	45
3.2.3	Loop by Loop Algorithm	47
3.3	Sewer Sizing.	49
3.3.1	Sewer Hydraulics.	50
3.3.2	Self-adaptive Sewer Sizing Algorithm	51
3.4	Design Objective Functions	54
3.5	Optimization Methods.	57
3.5.1	Genetic Algorithm (GA)	58
3.5.2	Simulated Annealing (SA).	59
3.5.3	Particle Swarm Optimization (PSO).	60
3.5.4	Tabu Search (TS)	61
3.6	Summary and Conclusion	63
	References.	64
4	A Norm-Aware Multi-agent System for Social Simulations in a River Basin.	67
	Ignasi Gómez-Sebastià, Luis Oliva-Felipe, Ulises Cortés, Marta Verdaguer, Manel Poch, Ignasi Rodríguez-Roda and Javier Vázquez-Salceda	
4.1	Introduction	68
4.2	Methodology.	70
4.2.1	Schema of Wastewater Flows in the Case Study	70
4.3	Tragedy of the Commons	71
4.3.1	Designing Institutions for CPR	73

4.4	Wastewater Systems' Organizational Model	74
4.4.1	Social Structure	75
4.4.2	Interaction Structure	77
4.4.3	Social Model	78
4.5	Agents: Behavior and Decision-Making	79
4.6	Norms.	81
4.6.1	Obligation Prospective Add.	82
4.6.2	Obligation Prospective Remove.	84
4.7	Conclusions and Related Work.	85
	References.	89
5	Decision Making in Solid Waste Management	
	Under Fuzzy Environment	91
	Selman Karagoz, Nezir Aydin and Erkan Isikli	
5.1	Introduction	91
5.2	Methodology-Fuzzy Multi-objective LP	95
5.2.1	The Interactive Fuzzy Multi-objective Approach	96
5.3	The Experimental Study	100
5.3.1	Mathematical Model	100
5.3.2	Data Acquisition	105
5.3.3	An Interactive Fuzzy Application in Multi-objective Programming	109
5.4	Conclusion	112
	References.	113
Part II Disaster Response Management		
6	Application of Fuzzy Rules to the Decision Process in Crisis	
	Management: The Case of the Silesian District in Poland	119
	Dorota Kuchta, Stanisław Stanek, Stanisław Drosio and Barbara Gładysz	
6.1	Introduction	119
6.2	Crisis Management—The Need for Flexibility and for Handling Incomplete Information.	120
6.3	Fuzzy Approach in Decision Making	121
6.4	Application of Fuzzy Rules to Crisis Management: State-of-the-Art.	122
6.5	Case Study—Hydrological Control of a Department	123
6.6	Crisp HAZOP Method in Decision Making	125
6.7	Generalised Fuzzy HAZOP Method	127
6.8	Case Study—Terrorism or Bioterrorism Act in the Department.	128
6.8.1	Application of the Fuzzified HAZOP Method	130
6.8.2	Application of Generalised HAZOP Methods	132
6.9	Conclusions	132
	References.	133

7	Maritime Environmental Disaster Management Using Intelligent Techniques.	135
	Emre Akyuz, Esra Ilbahar, Selcuk Cebi and Metin Celik	
7.1	Introduction	136
7.2	Maritime Environmental Disasters	137
7.3	Intelligent Systems	140
7.4	Applications of Intelligent Techniques to Maritime Industry . . .	142
7.4.1	Applications of Simulated Annealing	142
7.4.2	Applications of Genetic Algorithm	143
7.4.3	Applications of Ant Colony Optimization	143
7.4.4	Applications of Tabu Search	145
7.4.5	Applications of Particle Swarm Optimization	146
7.4.6	Applications of Artificial Neural Networks	146
7.4.7	Applications of Support Vector Machines	147
7.4.8	Applications of Branch-and-Bound	148
7.4.9	Applications of Fuzzy Logic	148
7.5	Maritime Intelligent Environmental Management Framework	149
7.6	Conclusion	152
	References.	152
 Part III Energy Management		
8	Modelling Solar Energy Usage with Fuzzy Cognitive Maps.	159
	Veysel Çoban and Sezi Çevik Onar	
8.1	Introduction	159
8.2	Renewable Energy	160
8.3	Solar Energy.	161
8.4	Fuzzy Cognitive Maps	162
8.5	Application.	167
8.6	Conclusion	185
	References.	186
9	Planning of Efficient Natural Gas Consumption in a Combined Cycle Gas Turbine Power Plant Using Evolutionary Algorithms	189
	H. Kutay Tinç and İrem Uçal Sarı	
9.1	Introduction	189
9.2	Literature Review	191
9.3	Evolutionary Algorithms.	192
9.4	Natural Gas Power Plant Systems.	193
9.5	Modelling Natural Gas Consumption	194
9.5.1	Day Ahead Market Price.	194
9.5.2	Natural Gas Power Plant Schedule Optimization.	196
9.5.3	Using the Model to Determine the Best Scenario	199

9.6	Application of the Proposed Model on a Medium Scale Natural Gas Power Plant for 2016 Market Clearing Price Forecasts.	199
9.7	Conclusion	202
	References.	203

Part IV Water Resources Management

10	Water Resources Management Decision-Making Under Stochastic Uncertainty Using a Firefly Algorithm-Driven Simulation-Optimization Approach for Generating Alternatives	207
	Julian Scott Yeomans	
10.1	Introduction	208
10.2	Modelling to Generate Alternatives	211
10.3	Firefly Algorithm for Function Optimization	213
10.4	A Simulation-Optimization Approach for Stochastic Optimization.	215
10.5	FA-Driven SO Algorithm for Stochastic MGA.	217
10.6	Case Study of Water Resources Management Under Uncertainty	220
10.6.1	Mathematical Model for the WRM Planning Case	221
10.6.2	Using the Co-evolutionary MGA Method for the WRM Planning Case	223
10.7	Conclusions	225
	References.	225
11	Fuzzy Neural Network (EFuNN) for Modelling Dissolved Oxygen Concentration (DO).	231
	Salim Heddam	
11.1	Introduction	231
11.2	Study Area and Data Used	233
11.2.1	Data.	233
11.2.2	Performance Indices	237
11.3	Models	237
11.3.1	Evolving Fuzzy Neural Network (EFuNN)	237
11.3.2	Multiple Linear Regression	240
11.4	Results and Discussions	240
11.4.1	Predicting DO for the Top Station (USGS 11509370).	241
11.4.2	Predicting DO of Bottom Station (USGS 420741121554001)	243
11.4.3	Predicting DO of the Top Station Using Input Data of Bottom Station	246

11.4.4	Predicting DO of the Bottom Station Using Input Data of the Top Station	247
11.5	Conclusions	249
	References.	250

Part V Sustainability

12	Cumulative Belief Degrees Approach for Assessment of Sustainable Development	257
	Hazal Ünlüçay, Beyzanur Çayır Ervural, Bilal Ervural and Özgür Kabak	
12.1	Introduction	257
12.2	Sustainable Development Indicators	261
12.2.1	Theme 1: Subjective Well-Being	263
12.2.2	Theme 2: Consumption and Income	265
12.2.3	Theme 3: Nutrition	266
12.2.4	Theme 4: Health	267
12.2.5	Theme 5: Labour.	267
12.2.6	Theme 6: Education	268
12.2.7	Theme 7: Housing.	268
12.2.8	Theme 8: Leisure.	269
12.2.9	Theme 9: Physical Safety	269
12.2.10	Theme 10: Land and Ecosystems	269
12.2.11	Theme 11: Water.	270
12.2.12	Theme 12: Air Quality	270
12.2.13	Theme 13: Climate	271
12.2.14	Theme 14: Energy Resources	271
12.2.15	Theme 15: Mineral Resources (Excluding Coal and Peat).	271
12.2.16	Theme 16: Trust	272
12.2.17	Theme 17: Institutions.	272
12.2.18	Theme 18: Physical Capital.	273
12.2.19	Theme 19: Knowledge Capital	273
12.2.20	Theme 20: Financial Capital	274
12.3	Cumulative Belief Degrees Approach.	274
12.3.1	Transformation of the Data to the Belief Structure	275
12.3.2	Calculation of the CBDs	276
12.3.3	Aggregation of CBDs	276
12.3.4	Interpretation of Resulting CBDs.	277
12.4	Measuring Sustainable Development Performance of Countries	278
12.4.1	Data Collection and Normalization	278
12.4.2	Transformation of the Data to the Belief Structure and Calculation of the CBDs	279

12.4.3	Aggregation of CBDs	279
12.4.4	Sustainable Development Performance of Countries.	283
12.5	Conclusions	285
	Appendix: Sustainable Development Performance of Countries	286
	References.	288
13	Sustainable Supply Chains and Risk Management for E-Commerce Companies Using Fuzzy Inference System	291
	Sultan Ceren Oner and Basar Oztaysi	
13.1	Introduction	291
13.2	Sustainable Supply Chain Management and Risk Factors.	293
13.3	Supply Chain Management and Fuzzy Theory	298
13.3.1	Supply Chain Risk Management and Fuzzy Systems	298
13.3.2	Fuzzy Inference Systems	299
13.4	Application.	301
13.5	Three Dimensional Sensitivity Analysis and Discussion.	306
13.6	Conclusion	309
	References.	309
 Part VI Environmental Economics		
14	Fuzzy Economic Analysis Methods for Environmental Economics	315
	Cengiz Kahraman, İrem Uçal Sarı, Sezi Cevik Onar and Basar Oztaysi	
14.1	Introduction	315
14.2	Literature Review	316
14.3	Fuzzy Discounted Cash Flows Methods in Environmental Engineering.	319
14.3.1	Ordinary Fuzzy Environmental Economics Methods.	319
14.3.2	Type-2 Fuzzy Environmental Economics Methods . . .	321
14.3.3	Intuitionistic Fuzzy Environmental Economics Methods	325
14.3.4	Hesitant Fuzzy Environmental Economics Methods.	333
14.4	A Numerical Illustration	337
14.4.1	Solution Using Ordinary Fuzzy Annual Worth	338
14.4.2	Solution Using Intuitionistic Fuzzy Annual Worth . . .	341
14.4.3	Solution Hesitant Fuzzy Annual Worth	342
14.5	Conclusion	343
	References.	344

15	Economic Analysis of Municipal Solid Waste Collection Systems Using Type-2 Fuzzy Net Present Worth Analysis	347
	İrem Uçal Sarı and Cengiz Kahraman	
15.1	Introduction	347
15.2	Literature Review	349
15.3	Solid Waste Collection Systems	351
15.4	Interval Type-2 Fuzzy Net Present Value Analysis.	353
15.4.1	Type-2 Fuzzy Sets.	353
15.4.2	Defuzzification of Type-2 Fuzzy Numbers	354
15.4.3	Type-2 Fuzzy Net Present Worth Method	355
15.5	An Application	356
15.5.1	Economic Analysis of Option 1.	358
15.5.2	Economic Analysis of Option 2.	359
15.5.3	Comparison of the Options	360
15.6	Conclusion	362
	References.	362
 Part VII Land Use Planning		
16	Applications of Multicriteria Techniques to Plan the Harvest of a Forest Taken into Account Different Kinds of Objectives.	367
	M. Hernández, T. Gómez, J. Molina and M.A. León	
16.1	Introduction	367
16.2	A Multiobjective Harvest Scheduling Model	370
16.3	Application.	375
16.4	Conclusions	380
	References.	381
17	Analytic Hierarchy Process and Fuzzy Rule Based System-Integrated Methodology for Urban Land Use Planning	385
	Cigdem Kadaifci, Saliha Karadayi Usta and Emre Cevikcan	
17.1	Introduction	386
17.2	Literature Review	388
17.3	The Proposed Methodology	394
17.3.1	Analytic Hierarchy Process	396
17.3.2	Fuzzy Rule-Based Systems	397
17.4	Application	399
17.4.1	Scenario Analysis	404
17.5	Conclusion	408
	References.	408

Part VIII Sustainable Transportation

18 Fuzzy Optimal Allocation of Service Centers for Sustainable Transportation Networks Service.	415
Alexander Bozhenyuk, Stanislav Belyakov, Evgeniya Gerasimenko and Marina Savelyeva	
18.1 Introduction	415
18.2 Main Concepts and Definitions.	416
18.3 Fuzzy Antibase Set.	420
18.4 Fuzzy Base Set.	425
18.5 Vitality Fuzzy Set.	427
18.6 Example of Service Centers Finding.	429
18.7 Conclusion	435
References.	436
19 Intelligent Control of Traffic Flows for Sustainable Transportation Networks	439
Alexander Bozhenyuk, Stanislav Belyakov, Evgeniya Gerasimenko and Marina Savelyeva	
19.1 Introduction	439
19.2 Description of the Dynamic Geoinformation Model of Transport Systems	440
19.3 Development of Routing Procedural Model Under Given Fuzzy Distance with Temporal Dependence	443
19.3.1 Situation A1	444
19.3.2 Situation A2	446
19.3.3 Situation A3	447
19.4 Example of the Routing Procedural Model Under Fuzzy Given Distance with Temporal Dependence.	447
19.4.1 Situation A1. Define the Time of Departure of the Material Flow $T_{j_s} = 0$	448
19.4.2 Situation A2. Define the Time of Arrival of the Material Flow $T_{j_r} = 8$	452
19.4.3 Situation A3. Set Interval of Time $T_{j_s} = 3$ and $T_{j_r} = 8$, Which is Necessary to Move from the Initial Vertex to the End Vertex.	454
19.5 Development of Routing Procedural Model Under Fuzzy Given Distance and Time	456
19.5.1 Situation A4	457
19.5.2 Situation A5	459
19.5.3 Situation A6	460

19.6 Example of the Routing Procedural Model Under
Fuzzy Given Distance and Time. 461

19.6.1 Situation A4. Define the Time of Departure
of the Material Flow $T_{j_s} = 0$ 462

19.7 Conclusion 465

References. 465

Index 467

Intelligence Systems in Environmental Management:
Theory and Applications

Kahraman, C.; Sari, I.U. (Eds.)

2017, XX, 468 p. 89 illus., 63 illus. in color., Hardcover

ISBN: 978-3-319-42992-2