

Contents

1	Introduction	1
1.1	Network Structure Analytics with Computational Intelligence	1
1.1.1	Concepts of Networks	2
1.1.2	Community Structure and Its Detection in Complex Networks	5
1.1.3	Structure Balance and Its Transformation in Complex Networks	9
1.1.4	Network Robustness and Its Optimization in Complex Networks	12
1.2	Book Structure	14
	References	15
2	Network Community Discovery with Evolutionary Single-Objective Optimization	21
2.1	Review of the State of the Art	21
2.2	A Node Learning-Based Memetic Algorithm for Community Discovery in Small-Scale Networks	22
2.2.1	Memetic Algorithm with Node Learning for Community Discovery	23
2.2.2	Problem Formation	24
2.2.3	Representation and Initialization	24
2.2.4	Genetic Operators	25
2.2.5	The Local Search Procedure	26
2.2.6	Experimental Results	27
2.2.7	Conclusions	34
2.3	A Multilevel Learning-Based Memetic Algorithm for Community Discovery in Large-Scale Networks	34
2.3.1	Memetic Algorithm with Multi-level Learning for Community Discovery	35
2.3.2	Representation and Initialization	35

2.3.3	Genetic Operators	35
2.3.4	Multi-level Learning Strategies	37
2.3.5	Complexity Analysis of MLCD.	43
2.3.6	Comparisons Between MLCD and Meme-Net.	44
2.3.7	Experimental Results.	45
2.3.8	Conclusions.	52
2.4	A Swarm Learning-Based Optimization Algorithm for Community Discovery in Large-Scale Networks	54
2.4.1	Greedy Particle Swarm Optimization for Network Community Discovery.	55
2.4.2	Particle Representation and Initialization.	55
2.4.3	Particle-Status-Updating Rules.	56
2.4.4	Particle Position Reordering	58
2.4.5	Experimental Results.	59
2.4.6	Additional Discussion on GDPSO.	65
2.4.7	Conclusions.	71
	References.	71
3	Network Community Discovery with Evolutionary Multi-objective Optimization	73
3.1	Review on the State of the Art.	73
3.2	A Decomposition Based Multi-objective Evolutionary Algorithm for Multi-resolution Community Discovery	74
3.2.1	Multi-objective Evolutionary Algorithm for Community Discovery	75
3.2.2	Problem Formation	76
3.2.3	Representation and Initialization	77
3.2.4	Genetic Operators	78
3.2.5	Experimental Results.	78
3.2.6	Conclusions.	84
3.3	A Multi-objective Immune Algorithm for Multi-resolution Community Discovery	84
3.3.1	Multi-objective Immune Optimization for Multi-resolution Communities Identification	85
3.3.2	Problem Formation	85
3.3.3	Proportional Cloning	86
3.3.4	Analysis of Computational Complexity.	88
3.3.5	Experimental Results.	88
3.3.6	Conclusions.	96
3.4	An Efficient Multi-objective Discrete Particle Swarm Optimization for Multi-resolution Community Discovery.	97
3.4.1	Multi-objective Discrete Particle Swarm Optimization for Multi-resolution Community Discovery.	97
3.4.2	Problem Formation	98

3.4.3	Definition of Discrete Position and Velocity	99
3.4.4	Discrete Particle Status Updating	99
3.4.5	Particle Swarm Initialization	102
3.4.6	Selection of Leaders	102
3.4.7	Turbulence Operator	103
3.4.8	Complexity Analysis	103
3.4.9	Experimental Results	104
3.4.10	Experimental Results on Signed Networks	116
3.4.11	Conclusions	118
3.5	A Multi-objective Evolutionary Algorithm for Community Discovery in Dynamic Networks	119
3.5.1	Multi-objective Optimization for Community Discovery in Dynamic Networks	119
3.5.2	Problem Formation	120
3.5.3	Proportional Cloning	121
3.5.4	Genetic Operators	122
3.5.5	The Local Search Procedure	122
3.5.6	Solution Selection	124
3.5.7	Experimental Results	125
3.5.8	Conclusions	131
	References	133
4	Network Structure Balance Analytics with Evolutionary Optimization	135
4.1	Review on the State of the Art	135
4.2	Computing Global Structural Balance Based on Memetic Algorithm	137
4.2.1	Memetic Algorithm for Computing Global Structural Balance	137
4.2.2	Representation and Initialization	138
4.2.3	Genetic Operators	138
4.2.4	The Local Search Procedure	139
4.2.5	Experimental Results	141
4.2.6	Complexity Analysis	145
4.2.7	Conclusions	146
4.3	Optimizing Dynamical Changes of Structural Balance Based on Memetic Algorithm	146
4.3.1	Problem Formation	146
4.3.2	Representation and Initialization	148
4.3.3	Genetic Operators	149
4.3.4	The Local Search Procedure	149
4.3.5	Transformation	150
4.3.6	Experimental Results	151
4.3.7	Conclusions	157

4.4	Computing and Transforming Structural Balance Based on Memetic Algorithm	158
4.4.1	Optimization Models	159
4.4.2	Memetic Algorithm for the Computation and Transformation of Structural Balance in Signed Networks	161
4.4.3	Experimental Results	169
4.4.4	Conclusions	180
4.5	Computing and Transforming Structural Balance Based on Evolutionary Multi-objective Optimization	181
4.5.1	The Two-Step Algorithm for Network Structural Balance	182
4.5.2	Model Selection	184
4.5.3	Complexity Analysis	186
4.5.4	Experimental Results	186
4.5.5	Conclusions	196
	References	197
5	Network Robustness Analytics with Optimization	201
5.1	Review on The State of the Art	201
5.2	Enhancing Community Integrity Against Multilevel Targeted Attacks	202
5.2.1	Model Malicious Attack on the Network as a Two-Level Targeted One	203
5.2.2	Community Robustness of Networks	205
5.2.3	Constraints for Improving Networks	207
5.2.4	Enhancing Community Robustness of Networks	208
5.2.5	Experimental Results	209
5.2.6	Conclusions	217
5.3	Enhancing Robustness of Coupled Networks Under Targeted Recoveries	217
5.3.1	Algorithm for Enhancing Robustness of Coupled Networks Under Targeted Recoveries	218
5.3.2	Experimental Results	223
5.3.3	Conclusions	226
	References	227
6	Real-World Cases of Network Structure Analytics	229
6.1	Review on the State of the Art	229
6.2	Community-Based Personalized Recommendation with Evolutionary Multiobjective Optimization	232
6.2.1	MOEA-Based Recommendation Algorithm	232
6.2.2	User Clustering	232
6.2.3	Problem Formation	233

- 6.2.4 Representation 234
- 6.2.5 Genetic Operators 234
- 6.2.6 Experimental Results 235
- 6.2.7 Conclusions 244
- 6.3 Influence Maximization in Social Networks with Evolutionary Optimization 244
 - 6.3.1 Memetic Algorithm for Influence Maximization in Social Networks 245
 - 6.3.2 Network Clustering 247
 - 6.3.3 Candidate Selection 247
 - 6.3.4 Seed Generation 248
 - 6.3.5 Experimental Results 253
 - 6.3.6 Conclusions 259
- 6.4 Global Biological Network Alignment with Evolutionary Optimization 259
 - 6.4.1 Problem Formation 260
 - 6.4.2 Optimization Model for Biological Network Alignment 260
 - 6.4.3 Memetic Algorithm for Network Alignment 261
 - 6.4.4 Representation and Initialization 262
 - 6.4.5 Genetic Operators 264
 - 6.4.6 The Local Search Procedure 264
 - 6.4.7 Experiments Results 266
 - 6.4.8 Conclusions 277
- References 277
- 7 Concluding Remarks 281**
 - 7.1 Future Directions and Challenges 281



<http://www.springer.com/978-981-10-4557-8>

Computational Intelligence for Network Structure
Analytics

Gong, M.; Cai, Q.; Ma, L.; Wang, S.; Lei, Y.

2017, XI, 283 p. 159 illus., 140 illus. in color., Hardcover

ISBN: 978-981-10-4557-8