

Contents

1 Multiobjective Genetic Algorithms	1
1.1 Introduction	1
1.1.1 General Structure of a Genetic Algorithm	2
1.1.2 Exploitation and Exploration	3
1.1.3 Population-based Search	4
1.1.4 Major Advantages	4
1.2 Implementation of Genetic Algorithms.....	5
1.2.1 GA Vocabulary	5
1.2.2 Encoding Issue	6
1.2.3 Fitness Evaluation	10
1.2.4 Genetic Operators.....	10
1.2.5 Handling Constraints	13
1.3 Hybrid Genetic Algorithms	15
1.3.1 Genetic Local Search	16
1.3.2 Parameter Adaptation.....	18
1.4 Multiobjective Genetic Algorithms	25
1.4.1 Basic Concepts of Multiobjctive Optimizations	26
1.4.2 Features and Implementation of Multiobjective GA.....	29
1.4.3 Fitness Assignment Mechanism	30
1.4.4 Performance Measures	41
References	44
2 Basic Network Models	49
2.1 Introduction	49
2.1.1 Shortest Path Model: Node Selection and Sequencing	50
2.1.2 Spanning Tree Model: Arc Selection	51
2.1.3 Maximum Flow Model: Arc Selection and Flow Assignment	52
2.1.4 Representing Networks	53
2.1.5 Algorithms and Complexity	54
2.1.6 NP-Complete	55
2.1.7 List of NP-complete Problems in Network Design	56

2.2	Shortest Path Model	57
2.2.1	Mathematical Formulation of the SPP Models	58
2.2.2	Priority-based GA for SPP Models.....	60
2.2.3	Computational Experiments and Discussions	72
2.3	Minimum Spanning Tree Models	79
2.3.1	Mathematical Formulation of the MST Models	83
2.3.2	PrimPred-based GA for MST Models	85
2.3.3	Computational Experiments and Discussions	96
2.4	Maximum Flow Model	96
2.4.1	Mathematical Formulation	99
2.4.2	Priority-based GA for MXF Model	100
2.4.3	Experiments	105
2.5	Minimum Cost Flow Model	107
2.5.1	Mathematical Formulation	108
2.5.2	Priority-based GA for MCF Model	110
2.5.3	Experiments	113
2.6	Bicriteria MXF/MCF Model	115
2.6.1	Mathematical Formulations	118
2.6.2	Priority-based GA for bMXF/MCF Model	119
2.6.3	i-awGA for bMXF/MCF Model	123
2.6.4	Experiments and Discussion	125
2.7	Summary	128
	References	130
3	Logistics Network Models	135
3.1	Introduction	135
3.2	Basic Logistics Models	139
3.2.1	Mathematical Formulation of the Logistics Models	139
3.2.2	Prüfer Number-based GA for the Logistics Models	146
3.2.3	Numerical Experiments	152
3.3	Location Allocation Models	154
3.3.1	Mathematical Formulation of the Logistics Models	156
3.3.2	Location-based GA for the Location Allocation Models	159
3.3.3	Numerical Experiments	170
3.4	Multi-stage Logistics Models	175
3.4.1	Mathematical Formulation of the Multi-stage Logistics	176
3.4.2	Priority-based GA for the Multi-stage Logistics	185
3.4.3	Numerical Experiments	190
3.5	Flexible Logistics Model	193
3.5.1	Mathematical Formulation of the Flexible Logistics Model	196
3.5.2	Direct Path-based GA for the Flexible Logistics Model	202
3.5.3	Numerical Experiments	206
3.6	Integrated Logistics Model with Multi-time Period and Inventory ..	208
3.6.1	Mathematical Formulation of the Integrated Logistics Model	210

3.6.2	Extended Priority-based GA for the Integrated Logistics Model	213
3.6.3	Local Search Technique	218
3.6.4	Numerical Experiments	221
3.7	Summary	222
	References	225
4	Communication Network Models	229
4.1	Introduction	229
4.2	Centralized Network Models	234
4.2.1	Capacitated Multipoint Network Models	235
4.2.2	Capacitated QoS Network Model	242
4.3	Backbone Network Model	246
4.3.1	Pierre and Legault's Approach	248
4.3.2	Numerical Experiments	252
4.3.3	Konak and Smith's Approach	253
4.3.4	Numerical Experiments	257
4.4	Reliable Network Models	257
4.4.1	Reliable Backbone Network Model	259
4.4.2	Reliable Backbone Network Model with Multiple Goals	269
4.4.3	Bicriteria Reliable Network Model of LAN	274
4.4.4	Bi-level Network Design Model	283
4.5	Summary	290
	References	291
5	Advanced Planning and Scheduling Models	297
5.1	Introduction	297
5.2	Job-shop Scheduling Model	303
5.2.1	Mathematical Formulation of JSP	304
5.2.2	Conventional Heuristics for JSP	305
5.2.3	Genetic Representations for JSP	316
5.2.4	Gen-Tsujimura-Kubota's Approach	325
5.2.5	Cheng-Gen-Tsujimura's Approach	326
5.2.6	Gonçalves-Magalhacs-Resende's Approach	330
5.2.7	Experiment on Benchmark Problems	335
5.3	Flexible Job-shop Scheduling Model	337
5.3.1	Mathematical Formulation of fJSP	338
5.3.2	Genetic Representations for fJSP	340
5.3.3	Multistage Operation-based GA for fJSP	344
5.3.4	Experiment on Benchmark Problems	353
5.4	Integrated Operation Sequence and Resource Selection Model	355
5.4.1	Mathematical Formulation of iOS/RS	358
5.4.2	Multistage Operation-based GA for iOS/RS	363
5.4.3	Experiment and Discussions	372
5.5	Integrated Scheduling Model with Multi-plant	376

5.5.1	Integrated Data Structure	379
5.5.2	Mathematical Models	381
5.5.3	Multistage Operation-based GA	383
5.5.4	Numerical Experiment	389
5.6	Manufacturing and Logistics Model with Pickup and Delivery	395
5.6.1	Mathematical Formulation	395
5.6.2	Multiobjective Hybrid Genetic Algorithm	399
5.6.3	Numerical Experiment	407
5.7	Summary	412
	References	412
6	Project Scheduling Models	419
6.1	Introduction	419
6.2	Resource-constrained Project Scheduling Model	421
6.2.1	Mathematical Formulation of rc-PSP Models	422
6.2.2	Hybrid GA for rc-PSP Models	426
6.2.3	Computational Experiments and Discussions	434
6.3	Resource-constrained Multiple Project Scheduling Model	438
6.3.1	Mathematical Formulation of rc-mPSP Models	440
6.3.2	Hybrid GA for rc-mPSP Models	444
6.3.3	Computational Experiments and Discussions	451
6.4	Resource-constrained Project Scheduling Model with Multiple Modes	457
6.4.1	Mathematical Formulation of rc-PSP/mM Models	457
6.4.2	Adaptive Hybrid GA for rc-PSP/mM Models	461
6.4.3	Numerical Experiment	470
6.5	Summary	472
	References	472
7	Assembly Line Balancing Models	477
7.1	Introduction	477
7.2	Simple Assembly Line Balancing Model	480
7.2.1	Mathematical Formulation of sALB Models	480
7.2.2	Priority-based GA for sALB Models	484
7.2.3	Computational Experiments and Discussions	492
7.3	U-shaped Assembly Line Balancing Model	493
7.3.1	Mathematical Formulation of uALB Models	495
7.3.2	Priority-based GA for uALB Models	499
7.3.3	Computational Experiments and Discussions	505
7.4	Robotic Assembly Line Balancing Model	505
7.4.1	Mathematical Formulation of rALB Models	509
7.4.2	Hybrid GA for rALB Models	512
7.4.3	Computational Experiments and Discussions	523
7.5	Mixed-model Assembly Line Balancing Model	526

7.5.1	Mathematical Formulation of mALB Models	529
7.5.2	Hybrid GA for mALB Models	532
7.5.3	Rekiek and Delchambre's Approach	542
7.5.4	Ozmehmehmet Tasan and Tunali's Approach	543
7.6	Summary	546
	References	546
8	Tasks Scheduling Models	551
8.1	Introduction	551
8.1.1	Hard Real-time Task Scheduling	553
8.1.2	Soft Real-time Task Scheduling	557
8.2	Continuous Task Scheduling	562
8.2.1	Continuous Task Scheduling Model on Uniprocessor System	563
8.2.2	Continuous Task Scheduling Model on Multiprocessor System	575
8.3	Real-time Task Scheduling in Homogeneous Multiprocessor	583
8.3.1	Soft Real-time Task Scheduling Problem (sr-TSP) and Mathematical Model	584
8.3.2	Multiobjective GA for srTSP	586
8.3.3	Numerical Experiments	592
8.4	Real-time Task Scheduling in Heterogeneous Multiprocessor System	595
8.4.1	Soft Real-time Task Scheduling Problem (sr-TSP) and Mathematical Model	595
8.4.2	SA-based Hybrid GA Approach	597
8.4.3	Numerical Experiments	601
8.5	Summary	602
	References	604
9	Advanced Network Models	607
9.1	Airline Fleet Assignment Models	607
9.1.1	Fleet Assignment Model with Connection Network	613
9.1.2	Fleet Assignment Model with Time-space Network	624
9.2	Container Terminal Network Model	636
9.2.1	Berth Allocation Planning Model	639
9.2.2	Multi-stage Decision-based GA	643
9.2.3	Numerical Experiment	646
9.3	AGV Dispatching Model	651
9.3.1	Network Modeling and Mathematical Formulation	652
9.3.2	Random Key-based GA	658
9.3.3	Numerical Experiment	664
9.4	Car Navigation Routing Model	666
9.4.1	Data Analyzing	667

9.4.2 Mathematical Formulation	670
9.4.3 Improved Fixed Length-based GA	672
9.4.4 Numerical Experiment	677
9.5 Summary	681
References	682
Index	687