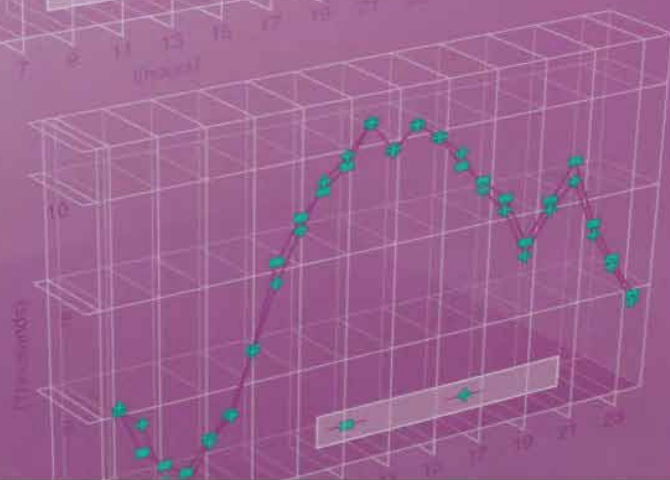
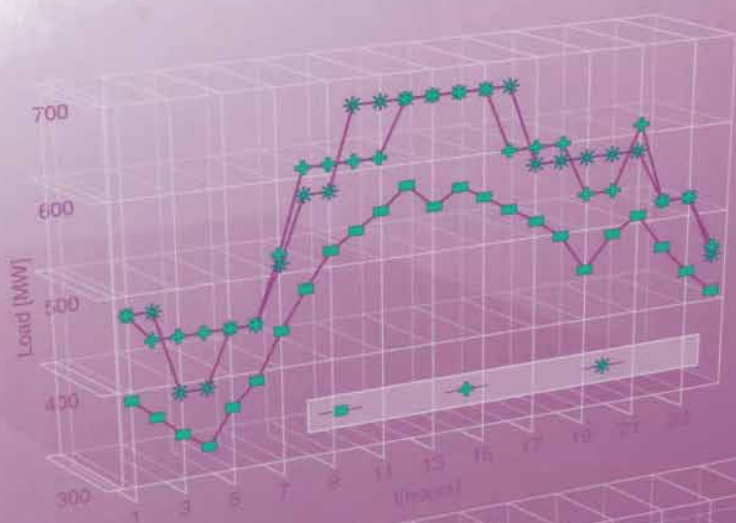


# MODERN HEURISTIC OPTIMIZATION TECHNIQUES

THEORY AND APPLICATIONS TO POWER SYSTEMS

EDITED BY

Kwang Y. Lee • Mohamed A. El-Sharkawi



## Provides power system engineers with basic knowledge of heuristic optimization techniques

Several heuristic tools have evolved in the last decade that facilitate solving optimization problems that were previously extremely challenging or even impossible to solve. Now, based on a successful tutorial given by the editors at IEEE Power Engineering Society conferences in New York and Toronto, *Modern Heuristic Optimization Techniques* explores how developing solutions with these tools offers two major advantages: shortened development time and more robust systems.

Composed of two parts, the book begins with an overview of modern heuristic techniques, including the fundamentals of evolutionary computation, genetic algorithms, evolutionary programming and strategies, particle swarm optimization, ant colony search algorithm, differential evolution, simulated annealing, tabu search, and hybrid systems of evolutionary computation. Next, it covers specific applications of heuristic approaches to power system problems, such as security assessment, optimal power flow, power system scheduling and operational planning, power generation expansion planning, reactive power planning, transmission and distribution planning, network reconfiguration, power plant control, power system control, and hybrid systems of heuristic methods.

Complemented with scores of drawings, charts, graphs, and tables that help bring the material to life, *Modern Heuristic Optimization Techniques* is the only book of its kind to provide a comprehensive treatment of the subject in a manner that is accessible to students and practitioners alike.

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## CONTENTS

<b>PREFACE</b>	<b>xxi</b>
<b>CONTRIBUTORS</b>	<b>xxvii</b>
<b>PART 1 THEORY OF MODERN HEURISTIC OPTIMIZATION</b>	<b>1</b>
<b>1 Introduction to Evolutionary Computation</b>	<b>3</b>
<i>David B. Fogel</i>	
1.1 Introduction, 3	
1.2 Advantages of Evolutionary Computation, 4	
1.2.1 Conceptual Simplicity, 4	
1.2.2 Broad Applicability, 6	
1.2.3 Outperform Classic Methods on Real Problems, 7	
1.2.4 Potential to Use Knowledge and Hybridize with Other Methods, 8	
1.2.5 Parallelism, 8	
1.2.6 Robust to Dynamic Changes, 9	
1.2.7 Capability for Self-Optimization, 10	
1.2.8 Able to Solve Problems That Have No Known Solutions, 11	
1.3 Current Developments, 12	
1.3.1 Review of Some Historical Theory in Evolutionary Computation, 12	
1.3.2 No Free Lunch Theorem, 12	
1.3.3 Computational Equivalence of Representations, 14	
1.3.4 Schema Theorem in the Presence of Random Variation, 16	
1.3.5 Two-Armed Bandits and the Optimal Allocation of Trials, 17	
1.4 Conclusions, 19	
Acknowledgments, 20	
References, 20	

**2 Fundamentals of Genetic Algorithms 25***Alexandre P. Alves da Silva and Djalma M. Falcão*

- 2.1 Introduction, 25
  - 2.2 Modern Heuristic Search Techniques, 25
  - 2.3 Introduction to GAs, 27
  - 2.4 Encoding, 28
  - 2.5 Fitness Function, 30
    - 2.5.1 Premature Convergence, 32
    - 2.5.2 Slow Finishing, 32
  - 2.6 Basic Operators, 33
    - 2.6.1 Selection, 33
      - 2.6.1.1 Tournament Selection, 34
      - 2.6.1.2 Truncation Selection, 34
      - 2.6.1.3 Linear Ranking Selection, 34
      - 2.6.1.4 Exponential Ranking Selection, 34
      - 2.6.1.5 Elitist Selection, 34
      - 2.6.1.6 Proportional Selection, 35
    - 2.6.2 Crossover, 36
    - 2.6.3 Mutation, 38
    - 2.6.4 Control Parameters Estimation, 38
  - 2.7 Niching Methods, 38
  - 2.8 Parallel Genetic Algorithms, 39
  - 2.9 Final Comments, 40
- Acknowledgments, 41  
References, 41

**3 Fundamentals of Evolution Strategies and Evolutionary Programming 43***Vladimiro Miranda*

- 3.1 Introduction, 43
- 3.2 Evolution Strategies, 46
  - 3.2.1 The General  $(\mu, \kappa, \lambda, \rho)$  Evolution Strategies Scheme, 47
  - 3.2.2 Some More Basic Concepts, 50
  - 3.2.3 The Early  $(1 + 1)$ ES and the  $1/5$  Rule, 51
  - 3.2.4 Focusing on the Optimum, 53
  - 3.2.5 The  $(1, \lambda)$ ES and  $\sigma$ SA Self-Adaptation, 54
  - 3.2.6 How to Choose a Value for the Learning Parameter?, 56
  - 3.2.7 The  $(\mu, \lambda)$ ES as an Extension of  $(1, \lambda)$ ES, 57
  - 3.2.8 Self-Adaptation in  $(\mu, \lambda)$ ES, 58

- 3.3 Evolutionary Programming, 60
    - 3.3.1 The  $(\mu + \lambda)$  Bridge to ES, 60
    - 3.3.2 A Scheme for Evolutionary Programming, 61
    - 3.3.3 Other Evolutionary Programming Variants, 63
  - 3.4 Common Features, 63
    - 3.4.1 Enhancing the Mutation Process, 63
    - 3.4.2 Recombination as a Major Factor, 65
    - 3.4.3 Handling Constraints, 67
    - 3.4.4 Starting Point, 67
    - 3.4.5 Fitness Function, 67
    - 3.4.6 Computing, 68
  - 3.5 Conclusions, 68
- References, 69

**4 Fundamentals of Particle Swarm Optimization Techniques 71***Yoshikazu Fukuyama*

- 4.1 Introduction, 71
  - 4.2 Basic Particle Swarm Optimization, 72
    - 4.2.1 Background of Particle Swarm Optimization, 72
    - 4.2.2 Original PSO, 72
  - 4.3 Variations of Particle Swarm Optimization, 76
    - 4.3.1 Discrete PSO, 76
    - 4.3.2 PSO for MINLPs, 77
    - 4.3.3 Constriction Factor Approach (CFA), 77
    - 4.3.4 Hybrid PSO (HPSO), 78
    - 4.3.5 Lbest Model, 79
    - 4.3.6 Adaptive PSO (APSO), 79
    - 4.3.7 Evolutionary PSO (EPSO), 81
  - 4.4 Research Areas and Applications, 82
  - 4.5 Conclusions, 83
- References, 83

**5 Fundamentals of Ant Colony Search Algorithms 89***Yong-Hua Song, Haiyan Lu, Kwang Y. Lee, and I. K. Yu*

- 5.1 Introduction, 89
- 5.2 Ant Colony Search Algorithm, 90
  - 5.2.1 Behavior of Real Ants, 90
  - 5.2.2 Ant Colony Algorithms, 91
    - 5.2.2.1 The Ant System, 94
    - 5.2.2.2 The Ant Colony System, 95
    - 5.2.2.3 The Max-Min Ant System, 95

- 5.2.3 Major Characteristics of Ant Colony Search Algorithms. 98
  - 5.2.3.1 Distributed Computation: Avoid Premature Convergence, 98
  - 5.2.3.2 Positive Feedback: Rapid Discovery of Good Solution, 98
  - 5.2.3.3 Use of Greedy Search and Constructive Heuristic Information: Find Acceptable Solutions in the Early Stage of the Process, 98

5.3 Conclusions, 99  
References, 99

**Fundamentals of Tabu Search** **101**

*Alcir J. Monticelli, Rubén Romero, and Eduardo Nobuhiro Asada*

- 6.1 Introduction, 101
  - 6.1.1 Overview of the Tabu Search Approach, 101
  - 6.1.2 Problem Formulation, 103
  - 6.1.3 Coding and Representation, 104
  - 6.1.4 Neighborhood Structure, 105
  - 6.1.5 Characterization of the Neighborhood, 108
- 6.2 Functions and Strategies in Tabu Search, 110
  - 6.2.1 Recency-Based Tabu Search, 110
  - 6.2.2 Basic Tabu Search Algorithm, 112
    - 6.2.2.1 Candidate List Strategies, 114
    - 6.2.2.2 Tabu Tenure, 114
    - 6.2.2.3 Aspiration Criteria, 115
  - 6.2.3 The Use of Long-Term Memory in Tabu Search, 115
    - 6.2.3.1 Frequency-Based Memory, 116
    - 6.2.3.2 Intensification, 116
    - 6.2.3.3 Diversification, 117
  - 6.2.4 Other TS Strategies, 118
    - 6.2.4.1 Path Relinking, 119
    - 6.2.4.2 Strategic Oscillation, 119

6.3 Applications of Tabu Search, 119  
6.4 Conclusions, 120  
References, 120

**7 Fundamentals of Simulated Annealing** **123**

*Alcir J. Monticelli, Rubén Romero, and Eduardo Nobuhiro Asada*

- 7.1 Introduction, 123
- 7.2 Basic Principles, 125
  - 7.2.1 Metropolis Algorithm, 125
  - 7.2.2 Simulated Annealing Algorithm, 126
- 7.3 Cooling Schedule, 127
  - 7.3.1 Determination of the Initial Temperature  $T_0$ , 128
  - 7.3.2 Determination of  $N_k$ , 129
  - 7.3.3 Determination of Cooling Rate, 130
  - 7.3.4 Stopping Criterion, 130
- 7.4 SA Algorithm for the Traveling Salesman Problem, 131
  - 7.4.1 Problem Coding, 131
  - 7.4.2 Evaluation of the Cost Function, 132
  - 7.4.3 Cooling Schedule, 133
  - 7.4.4 Comments on the Results for the TSP, 134
- 7.5 SA for Transmission Network Expansion Problem, 134
  - 7.5.1 Problem Coding, 136
  - 7.5.2 Determination of the Initial Solution, 136
  - 7.5.3 Neighborhood Structure, 138
  - 7.5.4 Variation of the Objective Function, 139
  - 7.5.5 Cooling Schedule, 140
- 7.6 Parallel Simulated Annealing, 140
  - 7.6.1 Division Algorithm, 141
  - 7.6.2 Clustering Algorithm, 142
- 7.7 Applications of Simulated Annealing, 143
- 7.8 Conclusions, 144  
References, 144

**8 Fuzzy Systems** **147**

*Germano Lambert-Torres*

- 8.1 Motivation and Definitions, 147
  - 8.1.1 Introduction, 147
  - 8.1.2 Typical Actions in Fuzzy Systems, 148
- 8.2 Integration of Fuzzy Systems with Evolutionary Techniques, 150
  - 8.2.1 Integration Types of Hybrid Systems, 150
    - 8.2.1.1 Stand-alone Systems, 150
    - 8.2.1.2 Weak Integration Systems, 150
    - 8.2.1.3 Fused Systems, 151

8.2.2	Hybrid Systems in Evolutionary Techniques,	151
8.2.3	Evolutionary Algorithms and Fuzzy Logic,	152
8.3	An Illustrative Example of a Hybrid System,	152
8.3.1	Parking Conditions,	153
8.3.2	Creation of the Fuzzy Control,	154
8.3.3	First Simulations,	156
8.3.4	Problem Presentation,	156
8.3.5	Genetic Training Modulus Description,	158
8.3.6	The Option to Define the Starting Positions,	158
8.3.7	The Option Genetic Training,	158
8.3.7.1	Genetic Representation of Solutions,	160
8.3.7.2	Evaluation Function,	160
8.3.7.3	Genetic Operators: Crossover and Mutation,	161
8.3.7.4	Renovation and Selection Criteria,	161
8.3.7.5	Stop Criteria,	162
8.3.7.6	Algorithm Presentation,	162
8.3.8	Tests,	163
8.4	Conclusions,	167
	References,	168
	<b>Differential Evolution, an Alternative Approach to Evolutionary Algorithm</b>	<b>171</b>
	<i>Kit Po Wong and ZhaoYang Dong</i>	
9.1	Introduction,	171
9.2	Evolutionary Algorithms,	172
9.2.1	Basic EAs,	172
9.2.2	Virtual Population-Based Acceleration Techniques,	174
9.3	Differential Evolution,	176
9.3.1	Function Optimization Formulation,	176
9.3.2	DE Fundamentals,	177
9.3.2.1	Initial Population,	178
9.3.2.2	Mutation and Recombination to Create New Vectors,	178
9.3.2.3	Selection and the Overall DE,	180
9.4	Key Operators for Differential Evolution,	181
9.4.1	Encoding,	181
9.4.2	Mutation,	181
9.4.3	Crossover,	183
9.4.4	Other Operators,	183
9.5	An Optimization Example,	184
9.6	Conclusions,	186

Acknowledgments,	186
References,	186

## 10 Pareto Multiobjective Optimization 189

*Patrick N. Ngatchou, Anahita Zarei, Warren L. J. Fox, and Mohamed A. El-Sharkawi*

10.1	Introduction,	189
10.2	Basic Principles,	190
10.2.1	Generic Formulation of MO Problems,	191
10.2.2	Pareto Optimality Concepts,	191
10.2.3	Objectives of Multiobjective Optimization,	193
10.3	Solution Approaches,	194
10.3.1	Classic Methods,	194
10.3.1.1	Weighted Aggregation,	194
10.3.1.2	Goal Programming,	195
10.3.1.3	$\epsilon$ -Constraint,	195
10.3.1.4	Discussion on Classic Methods,	195
10.3.2	Intelligent Methods,	196
10.3.2.1	Background,	196
10.3.2.2	Structure of Population-Based MOO Solvers,	196
10.3.2.3	Common Population-Based MO Algorithms,	200
10.3.2.4	Discussion on Modern Methods,	202
10.4	Performance Analysis,	202
10.4.1	Objective of Performance Assessment,	202
10.4.2	Comparison Methodologies,	203
10.4.2.1	Quality Indicators,	203
10.4.2.2	Attainment Function Method,	204
10.4.2.3	Dominance Ranking,	204
10.5	Conclusions,	205
	Acknowledgments,	205
	References,	205

## 11 Trust-Tech Paradigm for Computing High-Quality Optimal Solutions: Method and Theory 209

*Hsiao-Dong Chiang and Jaewook Lee*

11.1	Introduction,	209
11.2	Problem Preliminaries,	210
11.3	A Trust-Tech Paradigm,	213
11.3.1	Phase I,	213
11.3.2	Phase II,	214



- 11.4 Theoretical Analysis of Trust-Tech Method, 218
- 11.5 A Numerical Trust-Tech Method, 221
  - 11.5.1 Computing Another Local Optimal Solution, 222
    - 11.5.1.1 Method for Computing Exit Point, 222
    - 11.5.1.2 Method for Computing Dynamic Decomposition Point (DDP), 222
    - 11.5.1.3 Trust-Tech Method for Computing Another Local Optimal Solution, 223
  - 11.5.2 Computing Tier-One Local Optimal Solutions, 223
    - 11.5.2.1 Trust-Tech Method for Computing Tier-One Local Optimal Solutions, 224
  - 11.5.3 Computing Tier-N Solutions, 224
- 11.6 Hybrid Trust-Tech Methods, 225
- 11.7 Numerical Schemes, 227
- 11.8 Numerical Studies, 228
- 11.9 Conclusions Remarks, 231
- References, 232

## **PART 2 SELECTED APPLICATIONS OF MODERN HEURISTIC OPTIMIZATION IN POWER SYSTEMS** 235

### **12 Overview of Applications in Power Systems** 237

*Alexandre P. Alves da Silva, Djalma M. Falcão, and Kwang Y. Lee*

- 12.1 Introduction, 237
- 12.2 Optimization, 237
- 12.3 Power System Applications, 238
- 12.4 Model Identification, 239
  - 12.4.1 Dynamic Load Modeling, 239
  - 12.4.2 Short-Term Load Forecasting, 240
  - 12.4.3 Neural Network Training, 241
    - 12.4.3.1 Pruning Versus Growing, 241
    - 12.4.3.2 Types of Approximation Functions, 242
- 12.5 Control, 242
  - 12.5.1 Examples, 243
- 12.6 Distribution System Applications, 244
  - 12.6.1 Network Reconfiguration for Loss Reduction, 245
  - 12.6.2 Optimal Protection and Switching Devices Placement, 246
  - 12.6.3 Prioritizing Investments in Distribution Networks, 247

- 12.7 Conclusions, 249
- References, 250

### **13 Application of Evolutionary Technique to Power System Vulnerability Assessment** 261

*Mingoo Kim, Mohamed A. El-Sharkawi, Robert J. Marks, and Ioannis N. Kassabalidis*

- 13.1 Introduction, 261
- 13.2 Vulnerability Assessment and Control, 263
- 13.3 Vulnerability Assessment Challenges, 264
  - 13.3.1 Complexity of Power System, 264
  - 13.3.2 VA On-line Speed, 265
  - 13.3.3 Feature Selection, 265
    - 13.3.3.1 Fisher's Linear Discriminant: Selection Criteria, 266
    - 13.3.3.2 Neural Network Feature-Extraction (NNFE), 268
    - 13.3.3.3 Support Vector Machine Feature-Extraction, 270
  - 13.3.4 Vulnerability Border, 270
    - 13.3.4.1 Gradient Method, 272
    - 13.3.4.2 Evolutionary Computation Method, 272
    - 13.3.4.3 Enhanced Particle Swarm Optimization Method, 274
  - 13.3.5 Selection of Vulnerability Index, 276
    - 13.3.5.1 Vulnerability Index Based on Distance from a Border, 277
    - 13.3.5.2 Vulnerability Index Based on Anticipated Loss of Load, 278
- 13.4 Conclusions, 281
- References, 281

### **14 Applications to System Planning** 285

*Eduardo Nobuhiro Asada, Youngjae Jeon, Kwang Y. Lee, Vladimiro Miranda, Alcir J. Monticelli, Koichi Nara, Jong-Bae Park, Rubén Romero, and Yong-Hua Song*

- 14.1 Introduction, 285
- 14.2 Generation Expansion, 286
  - 14.2.1 A Coding Strategy for an Improved GA for the Least-Cost GEP, 288
  - 14.2.2 Fitness Function, 288
  - 14.2.3 Creation of an Artificial Initial Population, 289
  - 14.2.4 Stochastic Crossover, Elitism, and Mutation, 291
  - 14.2.5 Numerical Examples, 292
  - 14.2.6 Parameters for GEP and IGA, 293

- 14.2.7 Numerical Results, 295
- 14.3 Transmission Network Expansion, 297
  - 14.3.1 Overview of Static Transmission Network Planning, 297
  - 14.3.2 Solution Techniques for the Transmission Expansion Planning Problem, 300
  - 14.3.3 Coding, Problem Representation, and Test Systems, 302
  - 14.3.4 Complexity of the Test Systems, 304
  - 14.3.5 Simulated Annealing, 306
  - 14.3.6 Genetic Algorithms in Transmission Network Expansion Planning, 307
  - 14.3.7 Tabu Search in Transmission Network Expansion Planning, 309
  - 14.3.8 Hybrid TS/GA/SA Algorithm in Transmission Network Expansion Planning, 310
  - 14.3.9 Comments on the Performance of Meta-heuristic Methods in Transmission Network Expansion Planning, 311
- 14.4 Distribution Network Expansion, 311
  - 14.4.1 Dynamic Planning of Distribution System Expansion: A Complete GA Model, 312
  - 14.4.2 Dynamic Planning of Distribution System Expansion: An Efficient GA Application, 316
  - 14.4.3 Application of TS to the Design of Distribution Networks in FRIENDS, 317
- 14.5 Reactive Power Planning at Generation-Transmission Level, 320
  - 14.5.1 Benders Decomposition of the Reactive Power Planning Problem, 321
  - 14.5.2 Solution Algorithm, 323
  - 14.5.3 Results for the IEEE 30-Bus System, 324
- 14.6 Reactive Power Planning at Distribution Level, 326
  - 14.6.1 Modeling Chromosome Repair Using an Analytical Model, 326
  - 14.6.2 Evolutionary Programming/Evolution Strategies Under Test, 327
- 14.7 Conclusions, 330
- References, 330
- 15 Applications to Power System Scheduling 337**
  - Koay Chin Aik, Loi Lei Lai, Kwang Y. Lee, Haiyan Lu, Jong-Bae Park, Yong-Hua Song, Dipti Srinivasan, John G. Vlachogiannis, and I. K. Yu*
  - 15.1 Introduction, 337
  - 15.2 Economic Dispatch, 337
    - 15.2.1 Economic Dispatch Problem, 337
    - 15.2.2 GA Implementation to ED, 339
      - 15.2.2.1 Encoding Method, 340
      - 15.2.2.2 Constraints Handling, 341
      - 15.2.2.3 Genetic Operations, 342
      - 15.2.2.4 Fitness Function, 344
      - 15.2.2.5 Multistage Method and Directional Crossover, 345
  - 15.2.3 PSO Implementation to ED, 346
    - 15.2.3.1 Constraints Handling, 346
    - 15.2.3.2 Dynamic Space Reduction Strategy, 348
  - 15.2.4 Numerical Example, 348
    - 15.2.4.1 GA Implementation to ED with Smooth Cost Function, 348
    - 15.2.4.2 PSO Implementation to ED with Smooth/Nonsmooth Cost Function, 349
  - 15.2.5 Summary, 354
  - 15.3 Maintenance Scheduling, 354
    - 15.3.1 Maintenance Scheduling Problem, 354
    - 15.3.2 GA, PSO, and ES Implementation, 355
      - 15.3.2.1 Optimization Function, 355
      - 15.3.2.2 Total Operating Cost, 356
      - 15.3.2.3 Maintenance Cost, 356
      - 15.3.2.4 Penalty Cost, 356
      - 15.3.2.5 Overall Objective Function, 359
      - 15.3.2.6 Problem Representation, 360
    - 15.3.3 Simulation Results, 365
    - 15.3.4 Summary, 366
  - 15.4 Cogeneration Scheduling, 366
    - 15.4.1 Cogeneration Scheduling Problem, 367
    - 15.4.2 IGA Implementation, 370
    - 15.4.3 Case Study, 373
    - 15.4.4 Summary, 374
    - 15.4.5 Nomenclature, 379
      - 15.4.5.1 Thermal and Electric Variables, 379
      - 15.4.5.2 Data, 379
      - 15.4.5.3 Parameters, 379
  - 15.5 Short-Term Generation Scheduling of Thermal Units, 380
    - 15.5.1 Short-Term Generation Scheduling Problem, 380
    - 15.5.2 ACSA Implementation, 382
    - 15.5.3 Experimental results, 385
  - 15.6 Constrained Load Flow Problem, 385
    - 15.6.1 Constrained Load Flow Problem, 385
    - 15.6.2 Heuristic Ant Colony Search Algorithm Implementation, 386
      - 15.6.2.1 Problem Formulation, 386
      - 15.6.2.2 Construction Graph (AS-graph), 387
      - 15.6.2.3 ACSA for the CLF Problem, 387



15.6.3	Test Examples,	390
15.6.4	Summary,	399
	References,	399
<b>16</b>	<b>Power System Controls</b>	<b>403</b>
	<i>Yoshikazu Fukuyama, Hamid Ghezelayagh, Kwang Y. Lee, Chen-Ching Liu, Yong-Hua Song, and Ying Xiao</i>	
16.1	Introduction,	403
16.2	Power System Controls: Particle Swarm Technique,	404
16.2.1	Problem Formulation of VVC,	405
16.2.1.1	State Variables,	405
16.2.1.2	Problem Formulation,	406
16.2.2	Expansion of PSO for MINLP,	406
16.2.3	Voltage Security Assessment,	407
16.2.4	VVC Using PSO,	408
16.2.4.1	Treatment of State Variables,	408
16.2.4.2	VVC Algorithm Using PSO,	408
16.2.5	Numerical Examples,	409
16.2.5.1	IEEE 14 Bus System,	409
16.2.5.2	Practical 112 Bus Model System,	412
16.2.5.3	Large-Scale 1217 Bus Model System,	415
16.2.6	Summary,	416
16.3	Power Plant Controller Design with GA,	417
16.3.1	Overview of the GA,	417
16.3.2	The Boiler-Turbine Model,	419
16.3.3	The GA Control System Design,	420
16.3.3.1	PI Controller Design,	420
16.3.3.2	LQR Controller Design,	423
16.3.4	GA Design Results,	423
16.3.4.1	GA/PI Controller Results,	423
16.3.4.2	GA/LQR Controller Results,	425
16.3.4.3	Summary,	427
16.4	Evolutionary Programming Optimizer and Application in Intelligent Predictive Control,	427
16.4.1	Structure of the Intelligent Predictive Controller,	428
16.4.2	Power Plant Model,	430
16.4.3	Control Input Optimization,	431
16.4.4	Self-Organized Neuro-Fuzzy Identifier,	435
16.4.5	Rule Generation and Tuning,	438
16.4.6	Controller Implementation,	442
16.4.7	Summary,	444

16.5	An Interactive Compromise Programming-Based MO Approach to FACTS Control,	444
16.5.1	Review of MO Optimization Techniques,	446
16.5.1.1	Weighting Method,	447
16.5.1.2	Goal Programming,	447
16.5.1.3	$\epsilon$ -Constraint Method,	447
16.5.1.4	Compromise Programming,	447
16.5.1.5	Fuzzy Set Theory Applications,	448
16.5.1.6	Genetic Algorithm,	448
16.5.1.7	Interactive Procedure,	449
16.5.2	Formulated MO Optimization Model,	449
16.5.2.1	Formulated MO Optimization Model for FACTS Control,	450
16.5.3	Power Flow Control Model of FACTS Devices,	450
16.5.3.1	Control Variables,	450
16.5.3.2	Applied Power Flow Control Model,	453
16.5.4	Proposed Interactive DWCP Method,	453
16.5.4.1	Applied Fuzzy Compromise Programming,	453
16.5.4.2	Operation Cost Minimization,	454
16.5.4.3	Local Power Flow Control,	454
16.5.5	Proposed Interactive Procedure with Worst Compromise Displacement,	455
16.5.5.1	Phase 1: Model Formulation,	456
16.5.5.2	Phase 2: Noninferior Solution Calculation,	456
16.5.5.3	Phase 3: Scenario Evaluation,	456
16.5.6	Implementation,	457
16.5.7	Numerical Results,	457
16.5.8	Summary,	462
	References,	464

## 17 Genetic Algorithms for Solving Optimal Power Flow Problems 471

*Loi Lei Lai and Nidul Sinha*

17.1	Introduction,	471
17.2	Genetic Algorithms,	473
17.2.1	Terms Used in GA,	473
17.2.1.1	Search Space,	473
17.2.1.2	Chromosome,	474
17.2.1.3	Gene,	474
17.2.1.4	Population Size,	474
17.2.1.5	Fitness,	475
17.2.1.6	Initialization,	475

17.2.1.7	Creation of Offspring, 476	
17.2.1.8	Heuristic Crossover, 476	
17.2.1.9	Nonuniform Mutation, 477	
17.2.1.10	Normalized Geometric Selection, 477	
17.2.1.11	Crossover Probability, 478	
17.2.1.12	Mutation Probability, 478	
17.2.1.13	Stopping Rule, 478	
17.3	Load Flow Problem, 478	
17.4	Optimal Power Flow Problem, 483	
17.4.1	Application Examples, 485	
17.4.1.1	Optimal Power Flow Under Contingent Condition with Line Capacity Limit, 488	
17.4.1.2	Optimal Power Flow for Loss Minimization, 488	
17.5	OPF with FACTS Devices, 488	
17.5.1	FACTS Model, 492	
17.5.1.1	Phase Shifter, 492	
17.5.1.2	Series Compensator, 495	
17.5.2	Problem Formulation, 495	
17.5.3	Numerical Results, 496	
17.6	Conclusions, 499	
	References, 499	
<b>18</b>	<b>An Interactive Compromise Programming-Based Multiobjective Approach to FACTS Control</b>	<b>501</b>
	<i>Ying Xiao, Yong-Hua Song, and Chen-Ching Liu</i>	
18.1	Introduction, 501	
18.2	Review of Multiobjective Optimization Techniques, 503	
18.2.1	Weighting Method, 503	
18.2.2	Goal Programming, 504	
18.2.3	$\epsilon$ -Constraint Method, 504	
18.2.4	Compromise Programming, 504	
18.2.5	Fuzzy Set Theory Applications, 505	
18.2.6	Genetic Algorithm, 505	
18.2.7	Interactive Procedure, 506	
18.3	Formulated MO Optimization Model, 506	
18.3.1	Formulated MO Optimization Model for FACTS Control, 507	
18.3.2	Power Flow Control Model of FACTS Devices, 508	
18.3.2.1	Control Variables, 508	
18.3.2.2	Applied Power Flow Control Model, 509	

18.4	Proposed Interactive Displaced Worst Compromise Programming Method, 511
18.4.1	Applied Fuzzy CP, 511
18.4.2	Operation Cost Minimization, 512
18.4.3	Local Power Flow Control, 512
18.5	Proposed Interactive Procedure with WC Displacement, 513
18.5.1	Phase 1: Model Formulation, 513
18.5.2	Phase 2: Noninferior Solution Calculation, 514
18.5.3	Phase 3: Scenario Evaluation, 514
18.6	Implementation, 516
18.7	Numerical Results, 516
18.8	Conclusions, 521
	References, 521

## **19 Hybrid Systems**

525

*Vladimiro Miranda*

19.1	Introduction, 525
19.2	Capacitor Sizing and Location and Analytical Sensitivities, 527
19.2.1	From Darwin to Lamarck: Three Models, 528
19.2.2	Building a Lamarckian Acquisition of Improvements, 529
19.2.3	Analysis of a Didactic Example, 531
19.3	Unit Commitment, Fuzzy Sets, and Cleverer Chromosomes, 538
19.3.1	The Deceptive Characteristics of Unit Commitment Problems, 538
19.3.2	Similarity Between the Capacitor Placement and the Unit Commitment Problems, 539
19.3.3	The Need for Cleverer Chromosomes, 540
19.3.4	A Biological Touch: The Chromosome as a Program, 541
19.3.5	A Real-World Example: The CARE Model in Crete, Greece, 542
19.3.5.1	General Comments, 544
19.3.5.2	Evolutionary Process Techniques: Chromosome Compression Technique, 544
19.3.5.3	Evolutionary Process Techniques: Selection and Deterministic Crowding, 544
19.3.5.4	Evolutionary Process Techniques: Dynamic Mutation Rate, 544
19.3.5.5	Evolutionary Process Techniques: Crossover, 545
19.3.5.6	Evolutionary Process Techniques: Chromosome Repair, 545

- 19.3.5.7 Evolutionary Process Techniques: A Lamarckist Adaptation, 545
- 19.3.5.8 Fitness Evaluation: Dispatch with Fuzzy Wind Model, 545
- 19.3.5.9 Fitness Evaluation: Ramping Rules, 547
- 19.3.6 Fitness Evaluation: Reliability (Spinning Reserve as a Fuzzy Constraint), 547
- 19.3.7 Illustrative Results, 547
- 19.4 Voltage/Var Control and Loss Reduction in Distribution Networks with an Evolutionary Self-Adaptive Particle Swarm Optimization Algorithm: EPSO, 550
  - 19.4.1 Justifying a Hybrid Approach, 550
  - 19.4.2 The Principles of EPSO: Reproduction and Movement Rule, 551
  - 19.4.3 Mutating Strategic Parameters, 552
  - 19.4.4 The Merits of EPSO, 553
  - 19.4.5 Experiencing with EPSO: Basic EPSO Model, 554
  - 19.4.6 EPSO in Test Functions, 554
  - 19.4.7 EPSO in Loss Reduction and Voltage/VAR Control: Definition of the Problem, 557
  - 19.4.8 Applying EPSO in the Management of Networks with Distributed Generation, 558
- 19.5 Conclusions, 559
- References, 560

## INDEX

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**PREFACE**


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Several heuristic tools have evolved in the past decades that facilitate solving optimization problems that were previously difficult or impossible to solve. These tools include evolutionary computation, simulated annealing, tabu search, particle swarm, and so forth. Reports of applications of each of these tools have been widely published. Recently, these new heuristic tools have been combined among themselves and with knowledge elements, as well as with more traditional approaches such as statistical analysis, to solve extremely challenging problems. Developing solutions with these tools offers two major advantages: (1) development time is much shorter than when using more traditional approaches, and (2) the systems are very robust, being relatively insensitive to noisy and/or missing data.

The purpose of this book is to provide basic knowledge of evolutionary computation and other heuristic optimization techniques and how they are combined with knowledge elements in computational intelligence systems. Applications to power problems are stressed, and example applications are presented.

The book is composed of two parts: The first part gives an overview of modern heuristic optimization techniques, including fundamentals of evolutionary computation, genetic algorithms, evolutionary programming and strategies, particle swarm optimization, ant colony search algorithm, simulated annealing, tabu search, hybrid systems of evolutionary computation, and hybrid optimization of local heuristics and dynamical trajectory.

The second part of the book gives an overview of power system applications and deals with specific applications of the heuristic approaches to power system problems, such as security assessment, generation and maintenance scheduling, economic dispatch, transmission network expansion planning, generation expansion and reactive power planning, distribution system optimization, power plant and power system control, FACTS, and hybrid systems of heuristic methods.

### Evolutionary Computation

Natural evolution is a hypothetical population-based optimization process. Simulating this process on a computer results in stochastic optimization techniques that can often outperform classic methods of optimization when applied to difficult real-world problems. This tutorial provides a background in the inspiration, history, and application of evolutionary computation and other heuristic optimization methods to system identification, automatic control, gaming, and other combinatorial problems.