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Intelligent Optimisation Techniques

**Genetic Algorithms, Tabu Search, Simulated Annealing
and Neural Networks**

With 115 Figures



Springer

Preface

This book covers four optimisation techniques loosely classified as “intelligent”: genetic algorithms, tabu search, simulated annealing and neural networks.

- Genetic algorithms (GAs) locate optima using processes similar to those in natural selection and genetics.
- Tabu search is a heuristic procedure that employs dynamically generated constraints or tabus to guide the search for optimum solutions.
- Simulated annealing finds optima in a way analogous to the reaching of minimum energy configurations in metal annealing.
- Neural networks are computational models of the brain. Certain types of neural networks can be used for optimisation by exploiting their inherent ability to evolve in the direction of the negative gradient of an energy function and to reach a stable minimum of that function.

Aimed at engineers, the book gives a concise introduction to the four techniques and presents a range of applications drawn from electrical, electronic, manufacturing, mechanical and systems engineering. The book contains listings of C programs implementing the main techniques described to assist readers wishing to experiment with them.

The book does not assume a previous background in intelligent optimisation techniques. For readers unfamiliar with those techniques, Chapter 1 outlines the key concepts underpinning them. To provide a common framework for comparing the different techniques, the chapter describes their performances on simple benchmark numerical and combinatorial problems. More complex engineering applications are covered in the remaining four chapters of the book.

Chapter 2 comprises two sections. The first section presents four variations to the standard GA. The second section describes different GA applications, namely, design of fuzzy logic controllers, gearboxes and workplace layouts and training of recurrent neural networks for dynamic system modelling.

Chapter 3 studies the use of tabu search for designing microstrip antennas, training recurrent neural networks, designing digital FIR filters and tuning PID controller parameters.

Chapter 4 describes an application of simulated annealing to a real-time optimisation problem in the manufacture of optical fibre couplings. The chapter also reports on two other manufacturing engineering applications of simulated annealing, one concerned with the allocation of inspection stations in a multi-stage production system and the other with the selection of optimum lot sizes for batch production.

Chapter 5 outlines the use of neural networks to the problems of VLSI component placement and satellite broadcast scheduling.

In addition to the main chapters, the book also has six appendices. Appendices A1 and A2, respectively, provide background material on classical optimisation techniques and fuzzy logic theory. Appendices A3 to A6 contain the listings of C programs implementing the intelligent techniques covered in the book.

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Contents

1 Introduction	1
1.1 Genetic Algorithms	1
1.1.1 Background.....	1
1.1.2 Representation	2
1.1.3 Creation of Initial Population	3
1.1.4 Genetic Operators	3
1.1.5 Control Parameters	7
1.1.6 Fitness Evaluation Function.....	7
1.2 Tabu Search	8
1.2.1 Background.....	8
1.2.2 Strategies	8
1.3 Simulated Annealing	11
1.3.1 Background.....	11
1.3.2 Basic Elements.....	13
1.4 Neural Networks	15
1.4.1 Basic Unit	15
1.4.2 Structural Categorisation	18
1.4.3 Learning Algorithm Categorisation	19
1.4.4 Optimisation Algorithms.....	20
1.4.5 Example Neural Networks	22
1.5 Performance of Different Optimisation Techniques on Benchmark Test Functions.....	27
1.5.1 Genetic Algorithm Used	28
1.5.2 Tabu Search Algorithm Used.....	30
1.5.3 Simulated Annealing Algorithm Used	31
1.5.4 Neural Network Used	31
1.5.5 Results	33
1.6 Performance of Different Optimisation Techniques on Travelling Salesman Problem.....	44
1.6.1 Genetic Algorithm Used	44
1.6.2 Tabu Search Algorithm Used.....	45
1.6.3 Simulated Annealing Algorithm Used	45

1.6.4 Neural Network Used	46
1.6.5 Results	47
1.7 Summary	47
References.....	47
2 Genetic Algorithms.....	51
2.1 New Models.....	51
2.1.1 Hybrid Genetic Algorithm	51
2.1.2 Cross-Breeding in Genetic Optimisation	62
2.1.3 Genetic Algorithm with the Ability to Increase the Number of Alternative Solutions	63
2.1.4 Genetic Algorithms with Variable Mutation Rates	69
2.2 Engineering Applications.....	78
2.2.1 Design of Static Fuzzy Logic Controllers.....	78
2.2.2 Training Recurrent Neural Networks.....	97
2.2.3 Adaptive Fuzzy Logic Controller Design	111
2.2.4 Preliminary Gearbox Design.....	126
2.2.5 Ergonomic Workplace Layout Design.....	131
2.3 Summary	140
References.....	141
3 Tabu Search	149
3.1 Optimising the Effective Side-Length Expression for the Resonant Frequency of a Triangular Microstrip Antenna.....	149
3.1.1 Formulation.....	151
3.1.2 Results and Discussion	155
3.2 Obtaining a Simple Formula for the Radiation Efficiency of a Resonant Rectangular Microstrip Antenna.....	157
3.2.1 Radiation Efficiency of Rectangular Microstrip Antennas	159
3.2.2 Application of Tabu Search to the Problem.....	160
3.2.3 Simulation Results and Discussion	164
3.3 Training Recurrent Neural Networks for System Identification	165
3.3.1 Parallel Tabu Search.....	165
3.3.2 Crossover Operator.....	166
3.3.3 Training the Elman Network.....	167
3.3.4 Simulation Results and Discussion	168
3.4 Designing Digital Finite-Impulse-Response Filters	173
3.4.1 FIR Filter Design Problem.....	173
3.4.2 Solution by Tabu Search.....	174
3.4.3 Simulation Results	175
3.5 Tuning PID Controller Parameters	177

3.5.1	Application of Tabu Search to the Problem	178
3.5.2	Simulation Results	179
3.6	Summary	181
	References.....	182
4	Simulated Annealing.....	187
4.1	Optimal Alignment of Laser Chip and Optical Fibre	187
4.1.1	Background.....	187
4.1.2	Experimental Setup.....	188
4.1.3	Initial Results	192
4.1.4	Modification of Generation Mechanism	193
4.1.5	Modification of Cooling Schedule	193
4.1.6	Starting Point	194
4.1.7	Final Modifications to the Algorithm	195
4.1.8	Results	197
4.2	Inspection Stations Allocation and Sequencing	197
4.2.1	Background.....	198
4.2.2	Transfer Functions Model.....	200
4.2.3	Problem Description	202
4.2.4	Application of Simulated Annealing.....	204
4.2.5	Experimentation and Results	206
4.3	Economic Lot-Size Production	209
4.3.1	Economic Lot-Size Production Model.....	210
4.3.2	Implementation to Economic Lot-Size Production	213
4.4	Summary	217
	References.....	217
5	Neural Networks.....	219
5.1	VLSI Placement using MHSO Networks.....	219
5.1.1	Placement System Based on Mapping Self-Organising Network	221
5.1.2	Hierarchical Neural Network for Macro Cell Placement.....	225
5.1.3	MHSO2 Experiments.....	228
5.2	Satellite Broadcast Scheduling using a Hopfield Network	230
5.2.1	Problem Definition	231
5.2.2	Neural-Network Approach.....	233
5.2.3	Simulation Results	235
5.3	Summary	238
	References.....	238

Appendix 1 Classical Optimisation	241
A1.1 Basic Definitions.....	241
A1.2 Classification of Problems	243
A1.3 Classification of Optimisation Techniques.....	244
References.....	247
Appendix 2 Fuzzy Logic Control	249
A2.1 Fuzzy Sets	249
A2.1.1 Fuzzy Set Theory	249
A2.1.2 Basic Operations on Fuzzy Sets.....	250
A2.2 Fuzzy Relations.....	253
A2.3 Compositional Rule of Inference	254
A2.4 Basic Structure of a Fuzzy Logic Controller.....	255
A2.5 Studies in Fuzzy Logic Control.....	258
References.....	259
Appendix 3 Genetic Algorithm Program	263
Appendix 4 Tabu Search Program	271
Appendix 5 Simulated Annealing Program	279
Appendix 6 Neural Network Programs	285
Author Index	295
Subject Index	299