FEI-YUE WANG • DERONG LIU

ADVANCES IN

Computational Intelligence

Theory & Applications

Series in Intelligent Control and Intelligent Automation Vol. 5

Contents

Preface v

List of Contributors xiii

1 A Quest for Granular Computing and Logic Processing
W. Pedrycz **1**
1.1 Introduction 1
1.2 Granular Computing 2
1.3 Granular Computing and Logic: Synergistic Links 5
1.4 Main Categories of Fuzzy Logic Processing Units 7
1.5 A General Topology of the Network 15
1.6 Interpretation Issues of Logic Networks 17
1.7 Conclusions 19
Bibliography 19

2 Abstraction and Linguistic Analysis of Conventional Numerical Dynamic Systems
F.-Y. Wang **23**
2.1 Introduction 23
2.2 Type-I Linguistic Dynamic Systems 26
2.3 Type-II Linguistic Dynamic Systems 33
2.4 Linguistic Control Design for Goal States Specified in Words . . . 41
2.5 Conclusions 50
Bibliography 51

3 Slicing: A Distributed Learning Approach
S. A. Eschrich and L. O. Hall **55**

3.1 Introduction 56
3.2 Slicing 58
3.3 Variance Reduction in Slicing 60
3.4 Experiments 65
3.5 Analysis 87
3.6 Discussion 90
3.7 Conclusions 92
Bibliography 94

4 Marginal Learning Algorithms in Statistical Machine Learning
Q. Tao and J. Wang **99**
4.1 Introduction 100
4.2 Classification Problems and Margin 102
4.3 Maximal Margin Algorithm in SVM 103
4.4 Unbalanced Classification Problems and Weighted Maximal Margin Algorithms 107
4.5 The η-Unsupervised Learning Problems and Margin 121
4.6 Some Marginal Algorithms for One-Class Problems 127
4.7 Some New Algorithms of Clustering Problems 131
4.8 New Marginal Algorithms for PCA 134
4.9 Conclusions 139
Bibliography 139

5 Constraint Handling in Genetic Algorithm for Optimization
G. G. Yen **145**
5.1 Introduction 145
5.2 Literature Survey 148
5.3 Proposed Constraint Handling Scheme 153
5.4 Constrained Optimization – Algorithm Design 155
5.5 Selection Scheme Comparison Using TCG-2 159
5.6 Test Results 162
5.7 Conclusions 166
Bibliography 167

6 Hybrid PSO-EA Algorithm for Training Feedforward and Recurrent Neural Networks for Challenging Problems
X. Cai, G. K. Venayagamoorthy, and D. C. Wunsch II **171**

6.1 Introduction 171
6.2 PSO, EA and the Hybrid Algorithm 173
6.3 Feedforward Neural Networks as Board Evaluator for the Game Capture Go 179
6.4 Recurrent Neural Networks for Time Series Prediction 195
6.5 Conclusions 208
Bibliography 209

7 Modular Wavelet-Fuzzy Networks
Y. Lin and F.-Y. Wang **215**
7.1 Introduction 215
7.2 Wavelet Networks 217
7.3 Modular Structure of Wavelet-Fuzzy Networks 218
7.4 Learning Algorithm for Wavelet-Fuzzy Networks 230
7.5 Simulation Results 239
7.6 Conclusions 245
Bibliography 245

8 Ant Colony Algorithms: The State-of-the-Art
J. Zhang, J. Xu, and S. Zhang **249**
8.1 Introduction 249
8.2 Principles of ACO 250
8.3 Ant Colony Optimization 251
8.4 Applications of ACO Algorithms 253
8.5 Theoretical Research 261
8.6 Conclusions 261
Bibliography 261

9 Motif Discoveries in DNA and Protein Sequences Using Self-Organizing Neural Networks
D. Liu and X. Xiong **271**
9.1 Introduction 272
9.2 Subsequences and Encoding 276
9.3 Self-Organizing Neural Networks for Motif Identification 281
9.4 Simulation Results 290
9.5 Conclusions 297
Bibliography 298

10 Computational Complexities of Combinatorial Problems With Applications to Reverse Engineering of Biological Networks 303
P. Berman, B. DasGupta, and E. Sontag
10.1 Introduction . . . 303
10.2 Motivations . . . 304
10.3 Algorithms and Computational Complexities . . . 311
10.4 Conclusions . . . 314
Bibliography . . . 314

11 Advances in Fingerprint Recognition Algorithms with Application 317
J. Tian, X. Chen, Y. Zhang, and X. Yang
11.1 Introduction . . . 318
11.2 Advances in Fingerprint Recognition Algorithms . . . 320
11.3 Application to Fingerprint Mobile Phone . . . 332
11.4 Conclusions . . . 338
Bibliography . . . 339

12 Adaptation and Predictive Control Observed in Neuromuscular Control Systems 347
J. He
12.1 Introduction . . . 347
12.2 Control of Postural Stability . . . 349
12.3 Adaptive Control Strategy in Arm Reaching Movement . . . 367
12.4 Conclusions . . . 376
Bibliography . . . 376

13 Robust Adaptive Approximation Based Backstepping via Localized Adaptive Bounding 381
Y. Zhao and J. A. Farrell
13.1 Introduction . . . 381
13.2 Problem Formulation . . . 383
13.3 Adaptive Backstepping-Based Design . . . 386
13.4 Adaptive Bounding Methods . . . 393
13.5 Supplementary Information . . . 403
13.6 Numerical Example . . . 405
13.7 Conclusions . . . 409
Bibliography . . . 410

14 Dynamically Connected Fuzzy Single Input Rule Modules and Application to Underactuated Systems
J. Yi, N. Yubazaki, and K. Hirota **413**
14.1 Introduction 413
14.2 SIRMs Dynamically Connected Fuzzy Inference Model 415
14.3 Backing-Up Control of Truck-Trailer System 418
14.4 Stabilization Control of Ball-Beam System 426
14.5 Stabilization Control of Parallel-Type Double Inverted Pendulum System 433
14.6 Conclusions 446
Bibliography 447

Index **451**