

# Contents

## Part I: Pattern Recognition and Machine Intelligence

<b>1</b>	<b>A Review of Applications of Evolutionary Algorithms in Pattern Recognition</b> .....	<b>3</b>
1.1	Introduction .....	3
1.2	Basic Notions of Evolutionary Algorithms .....	4
1.3	A Review of EAs in Pattern Recognition .....	15
1.4	Future Research Directions .....	21
1.5	Conclusions .....	23
	References .....	24
<b>2</b>	<b>Pattern Discovery and Recognition in Sequences</b> .....	<b>29</b>
2.1	Introduction .....	29
2.2	Sequence Patterns and Pattern Discovery – A Brief Review ..	31
2.3	Our Pattern Discovery Framework .....	42
2.4	Conclusion .....	58
	References .....	58
<b>3</b>	<b>A Hybrid Method of Tone Assessment for Mandarin CALL System</b> .....	<b>61</b>
3.1	Introduction .....	61
3.2	Related Work .....	65
3.3	Proposed Approach .....	67
3.4	Experimental Procedure and Analysis .....	73
3.5	Conclusions .....	77
	References .....	78
<b>4</b>	<b>Fusion with Infrared Images for an Improved Performance and Perception</b> .....	<b>81</b>
4.1	Introduction .....	81
4.2	The Principle of Infrared Imaging .....	82
4.3	Fusion with Infrared Images .....	83
4.4	Applications .....	102
4.5	Summary .....	104
	References .....	105
<b>5</b>	<b>Feature Selection and Ranking for Pattern Classification in Wireless Sensor Networks</b> .....	<b>109</b>
5.1	Introduction .....	109

5.2	General Approach .....	112
5.3	Sensor Ranking .....	115
5.4	Experiments .....	118
5.5	Summary, Discussion and Conclusions .....	134
	References .....	136
<b>6</b>	<b>Principles and Applications of RIDED-2D – A Robust Edge Detection Method in Range Images .....</b>	<b>139</b>
6.1	Introduction .....	140
6.2	Definitions and Analysis .....	143
6.3	Principles of Instantaneous Denoising and Edge Detection .....	146
6.4	Experiments and Evaluations .....	151
6.5	Discussions and Applications .....	159
6.6	Conclusions and Prospects .....	163
	References .....	165
 <b>Part II: Computer Vision and Image Processing</b>		
<b>7</b>	<b>Lens Shading Correction for Dirt Detection .....</b>	<b>171</b>
7.1	Introduction .....	171
7.2	Background .....	174
7.3	Our Proposed Method .....	180
7.4	Experimental Results .....	184
7.5	Conclusions .....	194
	References .....	194
<b>8</b>	<b>Using Prototype-Based Classification for Automatic Knowledge Acquisition .....</b>	<b>197</b>
8.1	Introduction .....	197
8.2	Prototype-Based Classification .....	198
8.3	Methodology .....	204
8.4	Application .....	206
8.5	Results .....	208
8.6	Conclusion .....	211
	References .....	211
<b>9</b>	<b>Tracking Deformable Objects with Evolving Templates for Real-Time Machine Vision .....</b>	<b>213</b>
9.1	Introduction .....	213
9.2	Problem Formulation .....	216
9.3	Search Framework for Computing Template Position .....	218
9.4	Updating Framework for Computing Template Changes .....	224

9.5	Multiple Object Tracking and Intensity Information . . . . .	227
9.6	Experiments and Results . . . . .	229
9.7	Conclusions and Future Work . . . . .	233
	References . . . . .	234
<b>10</b>	<b>Human Extremity Detection for Action Recognition . . . .</b>	<b>237</b>
10.1	Introduction . . . . .	237
10.2	Relevant Works . . . . .	239
10.3	Extremities as Points on a Contour . . . . .	241
10.4	Extremities as Image Patches . . . . .	250
10.5	Experimental Results . . . . .	254
10.6	Conclusion . . . . .	258
	References . . . . .	259
<b>11</b>	<b>Ensemble Learning for Object Recognition and Tracking . . . . .</b>	<b>261</b>
11.1	Introduction . . . . .	261
11.2	Random Subspace Method . . . . .	264
11.3	Boosting Method . . . . .	269
	References . . . . .	276
<b>12</b>	<b>Depth Image Based Rendering . . . . .</b>	<b>279</b>
12.1	Introduction . . . . .	279
12.2	Depth Image Based Rendering . . . . .	283
12.3	Disocclusions . . . . .	289
12.4	Other Challenges . . . . .	304
12.5	Conclusion . . . . .	307
	References . . . . .	308
 <b>Part III: Face Recognition and Forensics</b> 		
<b>13</b>	<b>Gender and Race Identification by Man and Machine . . .</b>	<b>313</b>
13.1	Introduction . . . . .	313
13.2	Background . . . . .	314
13.3	Silhouetted Profile Faces . . . . .	315
13.4	Frontal Faces . . . . .	319
13.5	Fusing the Frontal View and Silhouetted Profile View Classifiers . . . . .	323
13.6	Human Experiments . . . . .	324
13.7	Observations and Discussion . . . . .	329
13.8	Concluding Remarks . . . . .	330
	References . . . . .	331

<b>14</b>	<b>Common Vector Based Face Recognition Algorithm</b>	335
14.1	Introduction	335
14.2	Algorithm Description	339
14.3	Two Methods Based on Common Vector	347
14.4	Experiments and Results	350
14.5	Conclusion and Future Research	358
	References	358
<b>15</b>	<b>A Look at Eye Detection for Unconstrained Environments</b>	361
15.1	Introduction	361
15.2	Related Work	363
15.3	Machine Learning Approach	364
15.4	Correlation Filter Approach	368
15.5	Experiments	370
15.6	Conclusions	385
	References	386
<b>16</b>	<b>Kernel Methods for Facial Image Preprocessing</b>	389
16.1	Introduction	389
16.2	Kernel PCA	391
16.3	Kernel Methods for Nonlinear Image Preprocessing	392
16.4	Face Image Preprocessing Using KPCA	397
16.5	Summary	407
	References	408
<b>17</b>	<b>Fingerprint Identification—Ideas, Influences, and Trends of New Age</b>	411
17.1	Introduction	411
17.2	System Architecture and Applications of Fingerprint Matching	415
17.3	The Early Years	419
17.4	Recent Feature Extraction Techniques—Addressing Core Problem	423
17.5	Conclusion and Future Directions	438
	References	439
<b>18</b>	<b>Subspaces Versus Submanifolds—A Comparative Study of Face Recognition</b>	447
18.1	Introduction	447
18.2	Notation and Definitions	449
18.3	Brief Review of Subspace-Based Face Recognition	

Algorithms	451
18.4 Submanifold-Based Algorithms for Face Recognition	453
18.5 Experiments Results and Analysis	472
18.6 Conclusion	480
References	481
<b>19 Linear and Nonlinear Feature Extraction Approaches for Face Recognition</b>	<b>485</b>
19.1 Introduction	485
19.2 Linear Feature Extraction Methods	488
19.3 Non-Linear Feature Extraction Methods	489
19.4 Conclusions	511
References	512
<b>20 Facial Occlusion Reconstruction Using Direct Combined Model</b>	<b>515</b>
20.1 Introduction	515
20.2 Direct Combined Model Algorithm	518
20.3 Reconstruction System	523
20.4 Experimental Results	528
20.5 Conclusions	530
References	530
<b>21 Generative Models and Probability Evaluation for Forensic Evidence</b>	<b>533</b>
21.1 Introduction	534
21.2 Generative Models of Individuality	535
21.3 Application to Birthdays	538
21.4 Application to Human Heights	540
21.5 Application to Fingerprints	544
21.6 Summary	557
References	559
<b>22 Feature Mining and Pattern Recognition in Multimedia Forensics – Detection of JPEG Image Based Steganography, Double-Compression, Interpolations and WAV Audio Based Steganography</b>	<b>561</b>
22.1 Introduction	562
22.2 Related Works	566
22.3 Statistical Characteristics and Modification	568
22.4 Feature Mining for JPEG Image Forensics	573
22.5 Derivative Based Audio Steganalysis	576

22.6	Pattern Recognition Techniques . . . . .	581
22.7	Experiments . . . . .	584
22.8	Conclusions . . . . .	600
	References . . . . .	601

## **Part IV: Biometric Authentication**

<b>23</b>	<b>Biometric Authentication . . . . .</b>	<b>607</b>
23.1	Introduction . . . . .	608
23.2	Basic Operations of a Biometric System . . . . .	616
23.3	Biometrics Standardization . . . . .	621
23.4	Certification of Biometric System . . . . .	622
23.5	Cloud Service—Web Service Authentication . . . . .	624
23.6	Challenges of Large Scale Deployment of Biometric Systems . . . . .	625
23.7	Conclusion . . . . .	628
	References . . . . .	630
<b>24</b>	<b>Radical-Based Hybrid Statistical-Structural Approach for Online Handwritten Chinese Character Recognition . . . .</b>	<b>633</b>
24.1	Introduction . . . . .	633
24.2	Overview of Radical-Based Approach . . . . .	635
24.3	Formation of Radical Models . . . . .	637
24.4	Radical-Based Recognition Framework . . . . .	643
24.5	Experiments . . . . .	650
24.6	Concluding Remarks . . . . .	653
	References . . . . .	654
<b>25</b>	<b>Current Trends in Multimodal Biometric System—Rank Level Fusion . . . . .</b>	<b>657</b>
25.1	Introduction . . . . .	657
25.2	Multimodal Biometric System . . . . .	660
25.3	Fusion in Multimodal Biometric System . . . . .	664
25.4	Rank Level Fusion . . . . .	667
25.5	Conclusion . . . . .	672
	References . . . . .	672
<b>26</b>	<b>Off-line Signature Verification by Matching with a 3D Reference Knowledge Image—From Research to Actual Application . . . . .</b>	<b>675</b>
26.1	Introduction . . . . .	675
26.2	Used Signature Data . . . . .	676

26.3	Image Types Used for Feature Extraction and Evaluation . . .	678
26.4	Skills of Forgery Creation of Used Forgeries . . . . .	680
26.5	Previous Work and Motivation for 3D RKI . . . . .	682
26.6	3D Reference Knowledge of Signature . . . . .	689
26.7	Ammar Matching Technique . . . . .	691
26.8	Feature Extraction . . . . .	694
26.9	Distance Measure and Verification . . . . .	695
26.10	Experimental Results and Discussion . . . . .	696
26.11	Limited Results are Shown and Discussed . . . . .	702
26.12	AMT Features and Signature Recognition . . . . .	703
26.13	AMT and Closely Related Works . . . . .	703
26.14	Transition from Research to Prototyping then Pilot Project and Actual Use . . . . .	704
26.15	Conclusions . . . . .	706
	References . . . . .	707
<b>27</b>	<b>Unified Entropy Theory and Maximum Discrimination on Pattern Recognition . . . . .</b>	<b>709</b>
27.1	Introduction . . . . .	709
27.2	Unified Entropy Theory in Pattern Recognition . . . . .	710
27.3	Mutual-Information—Discriminate Entropy in Pattern Recognition . . . . .	715
27.4	Mutual Information Discrimination Analysis in Pattern Recognition . . . . .	717
27.5	Maximum MI principle . . . . .	719
27.6	Maximum MI Discriminate SubSpace Recognition in Handwritten Chinese Character Recognition . . . . .	721
27.7	Conclusion . . . . .	725
	References . . . . .	731
<b>28</b>	<b>Fundamentals of Biometrics—Hand Written Signature and Iris . . . . .</b>	<b>733</b>
28.1	Prologue . . . . .	733
28.2	Fundamentals of Handwritten Signature . . . . .	735
28.3	Acquisition . . . . .	750
28.4	Databases . . . . .	751
28.5	Signature Analysers . . . . .	752
28.6	Off-line Methods . . . . .	754
28.7	On-line Methods . . . . .	756
28.8	Fundamentals of Iris . . . . .	760
28.9	Feature Extraction . . . . .	764

28.10	Preprocessing	771
28.11	Iris Image Databases	776
28.12	Iris Analyzers	776
28.13	Conclusion	780
	References	781
<b>29</b>	<b>Recent Trends in Iris Recognition</b>	<b>785</b>
29.1	Introduction	785
29.2	Basic Modules of Iris Recognition	786
29.3	Performance Measures	789
29.4	Limitations of Current Techniques	791
29.5	Future Scope	792
	References	793
<b>30</b>	<b>Using Multisets of Features and Interactive Feature Selection to Get Best Qualitative Performance for Automatic Signature Verification</b>	<b>797</b>
30.1	Introduction	797
30.2	Signature Data	799
30.3	ASV Systems Using Threshold-Based Decision	801
30.4	MSF and Its Performance	807
30.5	IFS and QP	813
30.6	Conclusion	819
	References	819
<b>31</b>	<b>Fourier Transform in Numeral Recognition and Signature Verification</b>	<b>823</b>
31.1	Concepts of Digital Transforms	823
31.2	Orthonormal System of Trigonometric Functions	824
31.3	Introduction to Discrete Fourier Transform	828
31.4	Properties of DFT	830
31.5	DFT Calculation Problem	833
31.6	Description of a Numeral Through Fourier Coefficients	837
31.7	Numeral Recognition Through Fourier Transform	842
31.8	Signature Verification Systems Through Fourier Analysis	847
31.9	On-line Signature Verification System Based on Fourier Analysis of Strokes	851
	References	854
	<b>Index</b>	<b>859</b>