

Contents

**Part I Introduction to Gait-Based Individual Recognition
at a Distance**

1	Introduction	3
1.1	Key Ideas Described in the Book	5
1.2	Organization of the Book	7

Part II Gait-Based Individual Recognition at a Distance

2	Gait Representations in Video	13
2.1	Human Motion Analysis and Representations	13
2.2	Human Activity and Individual Recognition by Gait	14
2.2.1	Human Recognition by Gait	15
2.2.2	Human Activity Recognition	17
2.3	Gait Energy Image (GEI) Representation	17
2.3.1	Motivation	18
2.3.2	Representation Construction	18
2.3.3	Relationship with MEI and MHI	18
2.3.4	Representation Justification	19
2.4	Framework for GEI-Based Recognition	21
2.4.1	Silhouette Extraction and Processing	21
2.4.2	Feature Extraction	22
2.5	Summary	24
3	Model-Free Gait-Based Human Recognition in Video	25
3.1	Statistical Feature Fusion for Human Recognition by Gait	25
3.1.1	Real and Synthetic Gait Templates	26
3.1.2	Human Recognition	28
3.1.3	Experimental Results	30
3.2	Human Recognition Based on Environmental Context	33
3.2.1	Walking Surface Type Detection	34
3.2.2	Classifier Design	37

3.2.3	Experimental Results	39
3.3	View-Insensitive Human Recognition by Gait	40
3.3.1	View-Insensitive Gait Templates	40
3.3.2	Human Recognition	42
3.3.3	Experimental Results	43
3.4	Human Repetitive Activity Recognition in Thermal Imagery	45
3.4.1	Object Detection in Thermal Infrared Imagery	46
3.4.2	Human Repetitive Activity Representation and Recognition	47
3.4.3	Experimental Results	48
3.5	Human Recognition Under Different Carrying Conditions	50
3.5.1	Technical Approach	50
3.5.2	Experimental Results	53
3.6	Summary	55
4	Discrimination Analysis for Model-Based Gait Recognition	57
4.1	Predicting Human Recognition Performance	57
4.2	Algorithm Dependent Prediction and Performance Bounds	58
4.2.1	Body Part Length Distribution	58
4.2.2	Algorithm Dependent Performance Prediction	60
4.2.3	Upper Bound on PCR	61
4.3	Experimental Results	62
4.4	Summary	63
5	Model-Based Human Recognition—2D and 3D Gait	65
5.1	2D Gait Recognition (3D Model, 2D Data)	65
5.1.1	3D Human Modeling	66
5.1.2	Human Recognition from Single Non-calibrated Camera	70
5.1.3	Human Recognition from Multiple Calibrated Cameras	76
5.2	Gait Recognition in 3D	80
5.2.1	Individual Recognition by Gait in 3D	80
5.2.2	Related Work	81
5.2.3	Technical Approach	83
5.2.4	Experimental Results	89
5.3	Summary	94
6	Fusion of Color/Infrared Video for Human Detection	95
6.1	Related Work	97
6.2	Hierarchical Image Registration and Fusion Approach	99
6.2.1	Image Transformation Model	100
6.2.2	Preliminary Human Silhouette Extraction and Correspondence Initialization	101

6.2.3	Automatic Image Registration	102
6.2.4	Sensor Fusion	107
6.2.5	Registration of EO/IR Sequences with Multiple Objects	108
6.3	Experimental Results	108
6.3.1	Image Registration Results	109
6.3.2	Sensor Fusion Results	112
6.4	Summary	113

Part III Face Recognition at a Distance in Video

7	Super-Resolution of Facial Images in Video at a Distance	117
7.1	Closed-Loop Super-Resolution of Face Images in Video	118
7.1.1	Related Work	118
7.1.2	Technical Approach	119
7.1.3	Experimental Results	122
7.2	Super-Resolution of Facial Images with Expression Changes in Video	124
7.2.1	Related Work	125
7.2.2	Technical Approach	126
7.2.3	Experimental Results	132
7.3	Constructing Enhanced Side Face Images from Video	137
7.3.1	Enhanced Side Face Image (ESFI) Construction	139
7.3.2	Technical Approach	139
7.4	Summary	148
8	Evaluating Quality of Super-Resolved Face Images	149
8.1	Image Quality Indices	149
8.2	Integrated Image Quality Index	150
8.2.1	Gray Scale Based Quality (Q_g)	152
8.2.2	Structure Based Quality (Q_e)	153
8.2.3	Similarity Between Input Images (Q_i)	154
8.2.4	Integrated Quality Measure (Q_{int})	155
8.3	Experimental Results for Face Recognition in Video	155
8.3.1	Experiment 1: Influence of Pose Variation on the Super- Resolved Face Image	156
8.3.2	Experiment 2: Influence of Lighting Variation on the Super-Resolved Face Image	158
8.3.3	Experiment 3: Influence of Facial Expression Variation on the Super-Resolved Face Image	159
8.3.4	Experiment 4: Influence of the Number of Images Used for Constructing the Super-Resolved Face Image for Face Recognition	160
8.3.5	Discussion	163
8.4	Summary	164

Part IV Integrated Face and Gait for Human Recognition at a Distance in Video

9	Integrating Face Profile and Gait at a Distance	167
9.1	Introduction	167
9.2	Technical Approach	169
9.2.1	High-Resolution Image Construction for Face Profile	169
9.2.2	Face Profile Representation and Matching	173
9.2.3	Gait Recognition	178
9.2.4	Integrating Face Profile and Gait for Recognition at a Distance	179
9.3	Experimental Results	179
9.3.1	Face Profile-Based Recognition	179
9.3.2	Integrating Face Profile With Gait	181
9.4	Summary	184
10	Match Score Level Fusion of Face and Gait at a Distance	185
10.1	Introduction	186
10.2	Related Work	187
10.3	Technical Approach	188
10.3.1	Enhanced Side Face Image Construction	189
10.3.2	Gait Energy Image Construction	190
10.3.3	Human Recognition Using ESFI and GEI	190
10.4	Experimental Results and Performance Analysis	193
10.4.1	Experiments and Parameters	193
10.4.2	Performance Analysis	201
10.5	Summary	206
11	Feature Level Fusion of Face and Gait at a Distance	209
11.1	Introduction	209
11.2	Technical Approach	212
11.2.1	Human Identification Using ESFI and GEI	214
11.3	The Related Fusion Schemes	216
11.3.1	Fusion at the Match Score Level [209]	217
11.3.2	Fusion at the Feature Level [207]	218
11.4	Experimental Results and Comparisons	218
11.4.1	Experiments and Parameters	218
11.4.2	Discussion on Experiments	230
11.5	Summary	232

Part V Conclusions for Integrated Gait and Face for Human Recognition at a Distance in Video

12	Conclusions and Future Work	235
12.1	Summary	235
12.1.1	Gait-Based Human Recognition at a Distance	235

12.1.2 Video-Based Human Recognition at a Distance 236

12.1.3 Fusion of Face and Gait for Human Recognition
at Distance 237

12.2 Future Research Directions 238

References 241

Index 251



<http://www.springer.com/978-0-85729-123-3>

Human Recognition at a Distance in Video

Bhanu, B.; Han, J.

2010, XXV, 253 p., Hardcover

ISBN: 978-0-85729-123-3