List of Figures

1.1 Correlation planes for authentic and impostor . . . . . . . . . . . . . . 2
1.2 Basic frequency domain correlation technique for face recognition . . 3
1.3 Pictorial representation of PSR calculation . . . . . . . . . . . . . . . . 4
1.4 PSR performance of different unconstrained filter . . . . . . . . . . . . 26
1.5 PSR performance of UMACE and PEUMACE . . . . . . . . . . . . . . 26
1.6 ROC plots of different correlation filters for YaleB . . . . . . . . . . . . 29
1.7 ROC plots of different correlation filters for AR database . . . . . . . 30
2.1 GRNN model used . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 42
2.2 Detail block diagram of face feature extraction using PCA . . . . . . 45
2.3 Scree plot and distribution of weights . . . . . . . . . . . . . . . . . . . 46
2.4 The amplification of PSR values . . . . . . . . . . . . . . . . . . . . . . 48
2.5 Off-line training of GRNN . . . . . . . . . . . . . . . . . . . . . . . . . 48
2.6 Online testing process of the proposed technique . . . . . . . . . . . . 49
2.7 Results of preprocessing of face images . . . . . . . . . . . . . . . . . . 50
2.8 Maximization of PSR separation by proposed technique . . . . . . . 52
2.9 PSR distribution comparison . . . . . . . . . . . . . . . . . . . . . . . . 53
2.10 Curves for probability of detection vs probability of false alarm . . . 54
2.11 Different synthetic occlusions on face image . . . . . . . . . . . . . . 57
2.12 Correlation planes in response to occluded images . . . . . . . . . . . 58
3.1 Filtering of original image by Mexican hat wavelet . . . . . . . . . . . 65
### LIST OF FIGURES

3.2 Improvement of PSR value for authentic persons using WMCF 68
3.3 PSR distribution of YaleB and PIE 69
3.4 ROC plots for Cropped YaleB faces of different filters 71
3.5 ROC plots for PIE faces of different filters 72
3.6 Images corrupted with Gaussian noise 73
3.7 Correlation planes in response to noisy authentic image 74
3.8 Correlation plane in response to noisy impostor image 74
3.9 ROC curves of Cropped YaleB with gaussian noise (mean=0) 75
3.10 ROC curves of Cropped YaleB with gaussian noise (variance=0.001) 76
3.11 ROC curves of PIE with gaussian noise (variance: 0.001 – 0.03) 77
3.12 ROC curves of PIE with gaussian noise (variance: 0.04 – 0.12) 78
3.13 ROC curves of PIE with gaussian noise (mean: 0.1 – 0.9) 79
3.14 ROC plots for comparison of WMCF with WaveMACH filter 80

4.1 Class compactness approach 85
4.2 Proposed technique for multi class face recognition 91
4.3 System flowchart 92
4.4 %FAR minimization during optimization of filter parameters 93
4.5 Rejection capability of the proposed filter 98
4.6 FAR corresponding to random and optimized parameters 98
4.7 Better rejection rate of Yale impostors 102
4.8 ROC plots for (a) Yale and (b) AR database for comparison 104

5.1 Face reconstruction and error plot 107
5.2 (a) Reconstruction error plot. (b) Error plot in log-error sense 110
5.3 Detail process of the proposed system 115
5.4 Correlation planes in response to 1st image from subset-5 117
5.5 Correlation planes in response to 1st image from PIE 118
5.6 PSR distributions of YaleB faces ........................................ 119
5.7 Demarcation between authentic and impostors ........................ 123
5.8 Detection performance with respect to ROC curves .......... 125

6.1 Block diagram of the proposed system ................................. 135
6.2 Response surfaces of nontrained authentic and impostors ....... 138
6.3 Probability distribution of authentic PSRs ............................ 140
6.4 ROC plots of filters with multi correlation approach .......... 142
6.5 Sensitivity of proposed filtering technique with respect to additive gaussian noise is shown for two different databases. 144

7.1 Detail process of face detection and recognition in video .......... 146
7.2 Detail training process and volumetric representation of UVF .... 152
7.3 Training of DCCFs .......................................................... 152
7.4 Detail face detection process from test video using UVF ......... 153
7.5 Some detected faces and corresponding correlation planes ...... 154
7.6 Both detected and not-detected frames are shown ................. 155
7.7 Classification accuracy while single individual video is trained 158
7.8 Classified and mis classified frames in video using proposed scheme 159

A.1 One individual from Yale face database .................................. 171
A.2 One individual from CMU-AMP database ............................... 172
A.3 One individual from YaleB database ...................................... 173
A.4 One individual from PIE database ......................................... 174
A.5 One individual from AR database ......................................... 174
A.6 Video frames of one individual from VidTIMIT database ........ 175