

Face Recognition Using Fuzzy Fisherface Classifier

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Contents

- Fuzzy Fisherface Approach
- Algorithm
- Flowchart
- Yale Database
- ORL Database
- Comparison of Recognition Rates
- Conclusion
- References



Fuzzy Fisherface Approach

- More sophisticated usage of class assignment of patterns (faces)
- Classification results affect the within-class and between-class scatter matrices

The Computations Of Membership Degrees

- Compute the membership grade to class i for j th pattern ,

$$\mu_{ij} \begin{cases} 0.51 + 0.49(n_{ij} / k) & \text{if } i = \text{same as the label of the } j\text{th pattern} \\ 0.49(n_{ij} / k) & \text{if } i \neq \text{same as the label of the } j\text{th pattern} \end{cases}$$

where n_{ij} is number of the neighbors of the j th data that belong to i th class

Algorithm

- Results of FKNN are used in computations of mean value and scatter covariance matrices,
- Mean vector of each class

$$\tilde{m}_i = \frac{\sum_{j=1}^N \mu_{ij} X_j}{\sum_{j=1}^N \mu_{ij}}$$

- The between class and within class fuzzy scatter matrices are respectively,

$$S_{FB} = \sum_{i=1}^c N_i (\tilde{m}_i - \bar{m})(\tilde{m}_i - \bar{m})^T$$

$$S_{FW} = \sum_{i=1}^c \sum_{x_k \in C_i} (x_k - \tilde{m}_i)(x_k - \tilde{m}_i)^T = \sum_{i=1}^c S_{FW_i}$$

Algorithm

- The optimal fuzzy projection W_{F-FLD} and feature vector transformed by fuzzy fisherface method are given by

$$W_{F-FLD} = \arg \max_W \frac{|W^T S_{FB} W|}{|W^T S_W W|}$$

$$\tilde{v}_i = W_{F-FLD}^T X_i = W_{F-FLD}^T E^T (z_i - \bar{z})$$

Flowchart

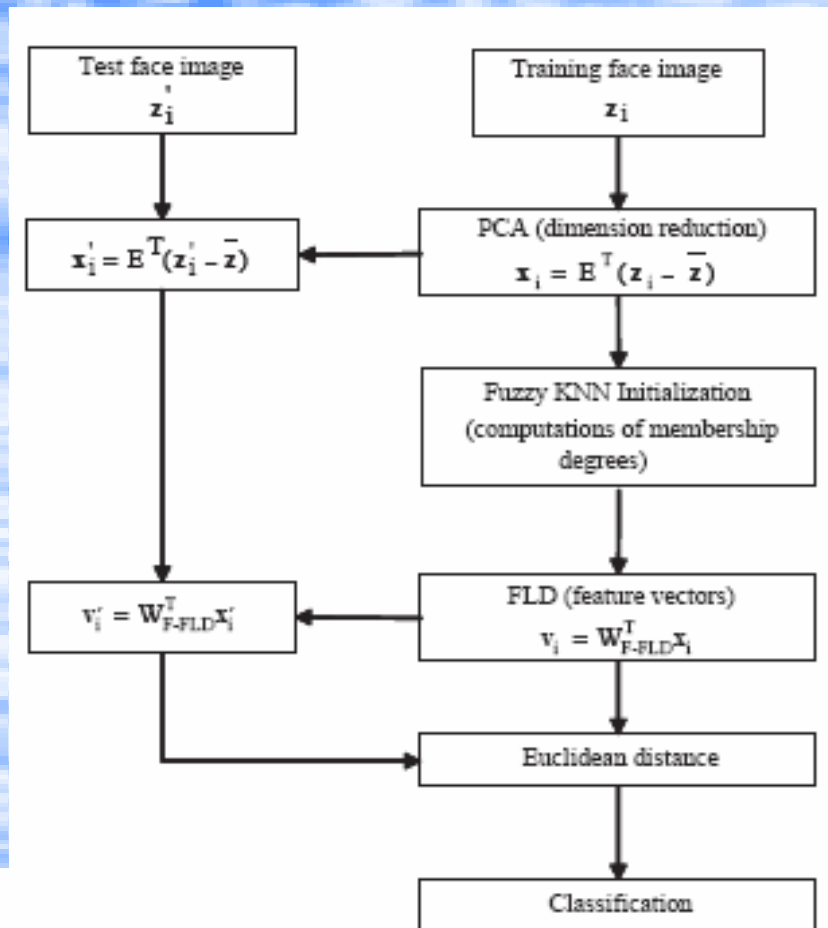


Fig.A general flow of computing for the fuzzy fisherface method.

Yale Database

- Total Images- 165, total Classes- 15 (11 Images For Each Class)
- One Image for each configuration: Center-light, glasses/no glasses, happy, normal, left/right light, sad, sleepy, surprised, wink.





Yale Database

- Mugshots were acquired using digicam,
- Each image was digitized and presented by a 243 X 320 pixel array

ORL Database

- Total Images: 400, total classes: 40 (10 Images for each class)
- Mugshots were acquired using DigiCam, varying facial details
- Each image was digitized and presented by a 112 X 92 pixel array



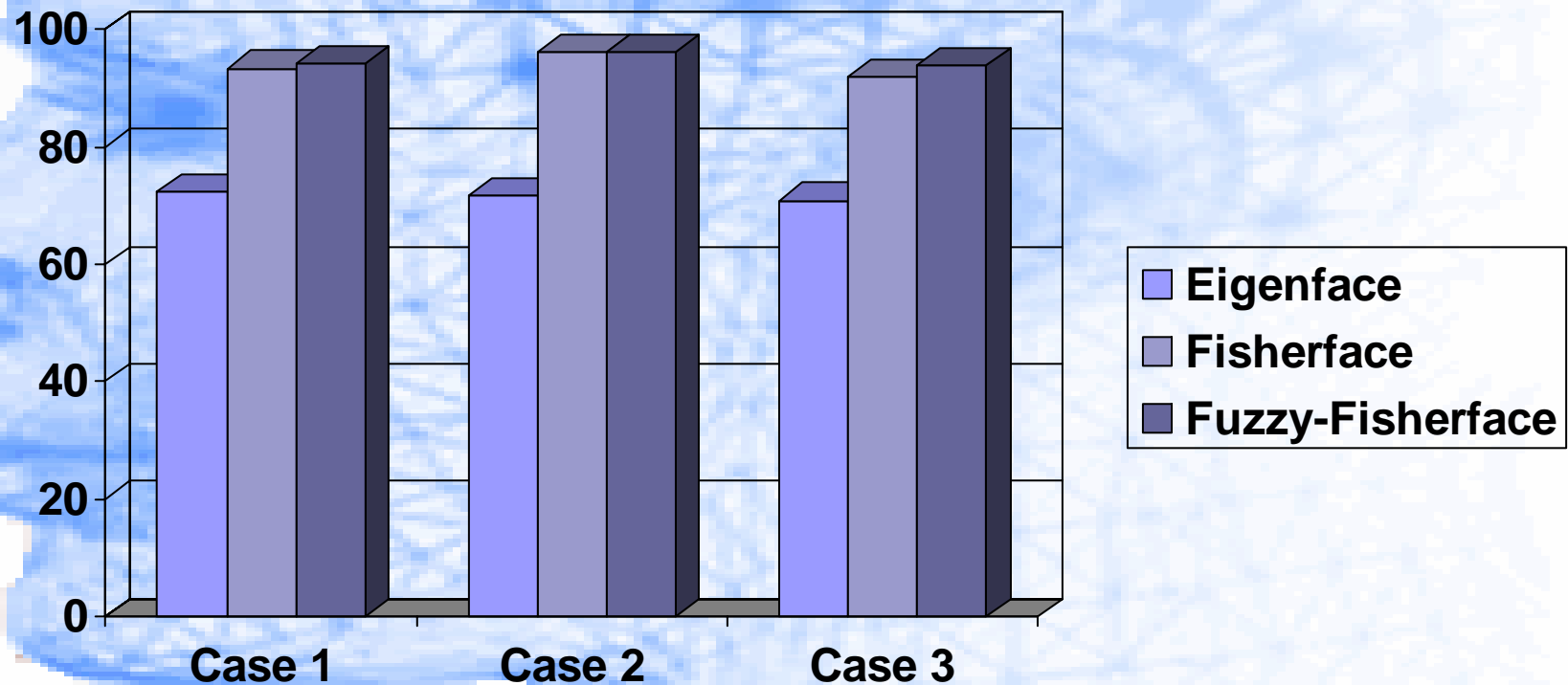
Comparison of Mean Recognition Rates (Yale)

	Eigenface (PCA) (%)	Fisherface (PCA+LDA)(%)	Fuzzy Fisherface (Fuzzy+PCA+LDA) (%)
Case 1 (6-training, 5-testing)	72.44	93.4	94.2
Case 2 (7-training, 4-testing)	71.66	96.04	96.24
Case 3 (5-training, 6-testing)	70.85	91.94	93.87

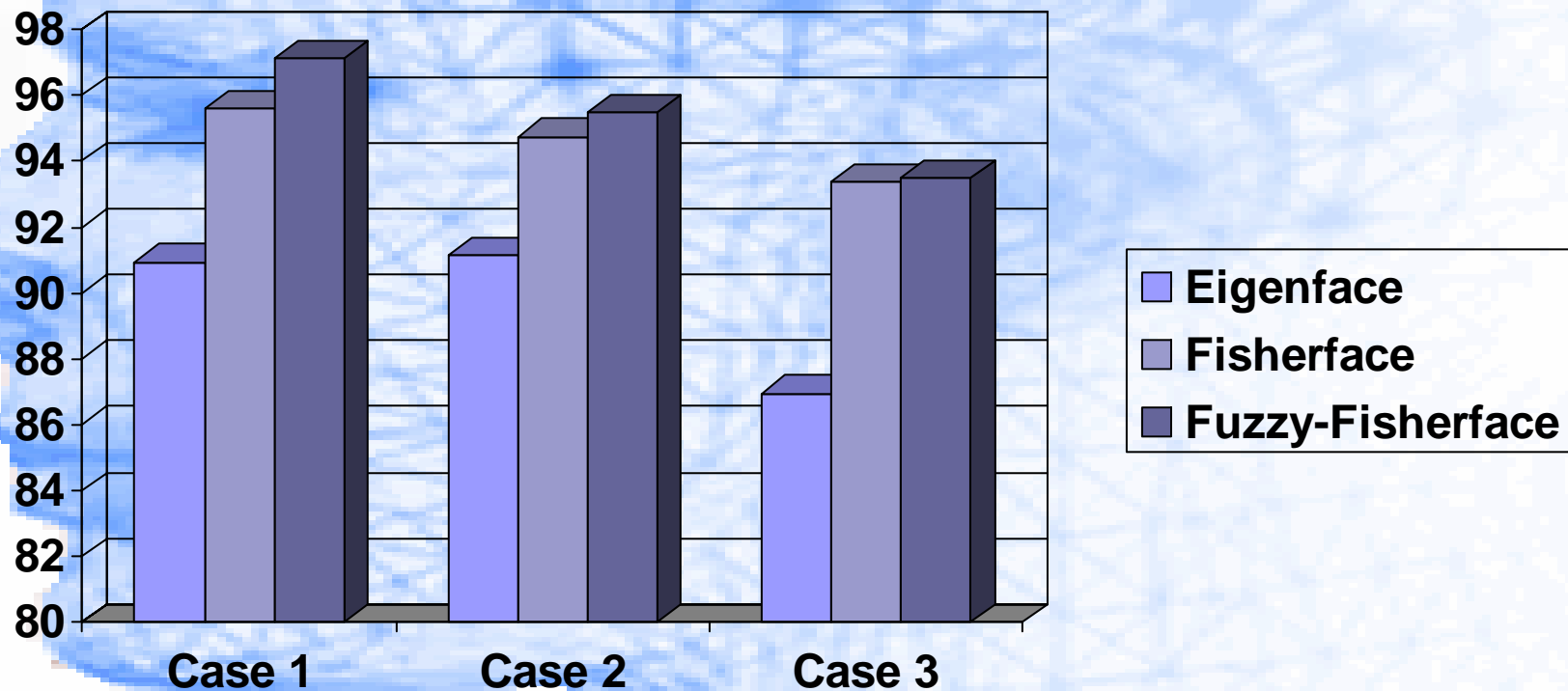
Comparison of Mean For Recognition Rates (ORL)

	Eigenface (PCA) (%)	Fisherface (PCA+LDA)(%)	Fuzzy Fisherface (Fuzzy+PCA+LDA) (%)
Case 1 (6-training, 4-testing)	90.94	95.59	97.12
Case 2 (5-training, 5-testing)	91.13	94.75	95.5
Case 3 (4-training, 6-testing)	86.94	93.38	93.50

Comparison of Recognition Rate For Yale Database



Comparison of Recognition Rate For ORL Database



Confusion Matrix (Yale)

Case 2(7/4)

Fisherface

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	3	1													
2		4													
3			4												
4				4											
5					4										
6						4									
7							4								
8								4							
9					1			1	2						
10										4					
11											4				
12												4			
13													4		
14														4	
15															4

Fuzzy Fisherface

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
1	4															
2		4														
3			4													
4				4												
5					4											
6						1	3									
7								4								
8									4							
9										4						
10											4					
11												4				
12													4			
13									1					3		
14															4	
15																4

Comparison

Input Image

Matched Image

Eigenface



Fisherface



Fuzzy Fisherface



Comparison

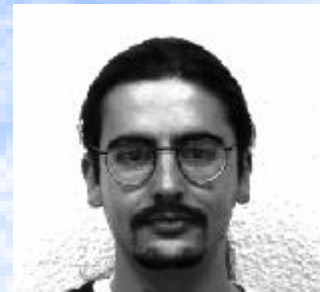
Input Image

Matched Image

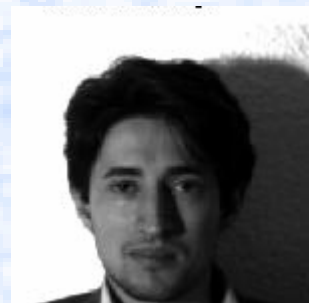
Eigenface



Fisherface



Fuzzy Fisherface



Comparison

Input Image

Matched Image

Eigenface



Fisherface



Fuzzy Fisherface



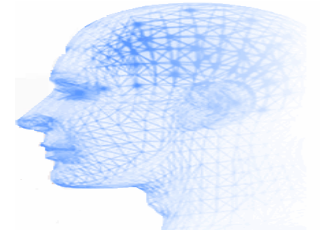


Conclusion

- Fuzzy fisherface approach outperforms the other two methods for the datasets considered.
- Sensitive to variations in illumination and facial expression reduced substantially.

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Thank You