Fisherfaces: Face Recognition using Class Specific Linear Projection

ABSTRACT

The variations between the images of the same face due to illumination and viewing direction are almost always larger than image variations due to change in face identity. In choosing the projection which maximizes total scatter, PCA retains unwanted variations due to lighting and facial expression. Even if the top three eigenfaces mostly correspond to changes in illumination, some information useful for discrimination may be lost.
So we implement face recognition using Fisher Linear Discriminant method and compare its performance with eigenfaces method on the Yale Databases. Apart from face recognition, we also implement expression identification (Here we classify happy/sad faces).

RESULTS

1. **Face recognition on Yale Database :**

    Training and testing is done using leave-one-out selection i.e we select an image as test image and use all remaining images as training set. This is repeated for all images in the database.

Method	Reduced space	Recognition rate
PCA with k = 14	14	0.8
PCA with k = 149	149	0.85
PCA with k = 14 (excluding top 3 eigenvectors)	14	0.87
PCA with k = 149 (excluding top 3 eigenvectors)	149	0.89
FLD	14	1

2. Face recognition on extended Yale Database :

Extrapolation :

Training set : Angles of illumination in 0 to 10
Testing set : Angles from 10 to 50

Number of images in training set : 263
Number of images in testing set : 982

Method	Reduced space	Recognition rate
PCA with k = 37	37	0.571
PCA with k = 60	60	0.592
PCA with k = 37 (excluding top 3 eigenvectors)	37	0.864
PCA with k = 60 (excluding top 3 eigenvectors)	60	0.887
FLD	37	0.937

Interpolation :

Training set : Angles of illumination in 0 to 10 and 110 to 130
Testing set : Angles from 10 to 110

Number of images in training set : 715
Number of images in testing set : 1700

Method	Reduced space	Recognition rate
PCA with k = 37	37	0.383
PCA with k = 60	60	0.436
PCA with k = 37	37	0.685

(excluding top 3 eigenvectors)		
PCA with k = 60 (excluding top 3 eigenvectors)	60	0.776
FLD	37	0.883

3. Expression Identification on Yale Database :

Training Phase : The images of first 10 persons are used for training the algorithm.
Two classes : Happy/Sad are used.
Testing Phase : The algorithm classifies the images of 5 persons as happy/sad.

Size of training set : 20
Size of testing set : 10
Recognition rate with PCA : 0.6
Recognition rate with FLD : 0.8

References :

1) Peter N. Belhumeur, Joao P. Hespanha, David J. Kriegman "Eigenfaces vs. Fisherfaces: Recognition Using Class Specific Linear Projection" IEEE Transactions on Pattern Analysis and Machine Intelligence (Volume: 19 , Issue: 7 , July 1997)