

# Face Recognition using PCA and LDA fusion techniques

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**Declaration:** I, Mr. Santosh Yadav Jada, hereby declare that the paper 'Face Recognition using PCA and LDA fusion techniques' is submitted by me based on the work carried out by me. Any reference to material obtained from other sources have been duly cited and referenced.

## Abstract

There are many face recognition algorithms present for the biometric systems. But a single classifier may not give the best of accuracy. So, we are going for a multi classifier system which would be a combination of two classifiers. In this paper, we are using PCA and LDA methods and fuse them at score level and check our results.

## Introduction

Face recognition has a lot of prominence in computer vision, image processing, etc. Every algorithm has strengths and drawbacks at various levels. So, to increase the accuracy and reliability, we are working with multi classifier system using PCA and LDA at score level using minimum, maximum and average rules. We also look into multi instance fusion, thereby making our system more robust and accurate for taking final decision. We have used AT&T database which has 10 images of 40 subjects for this project.

## Methods

We have used Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) which are feature extraction techniques which map the data of  $d$  dimension space in  $k$  ( $k < d$ ) dimensions with minimal loss of information ([1], page 116).

In PCA the data of  $D$  dimension is projected onto the subspace of  $K$  dimensions which is called Eigen Space. We find out the Eigen vectors, then select some which have highest value. Then we project the data and find out the euclidean distance between projected and test data to get scores. For these scores we create targets and we get ROC. Same kind of process is done with LDA but there we have Fisher Space and finally we get the scores of this classifier. In Score Level fusion, the match outputs are combined to improve the matching performance in face recognition ([2], page 161). This fusion technique could be applied using rules like sum, average, min and max ([3]).

For Experiment A, we have to combine the score by voting and use fusion techniques and calculate ROC. For Experiment B, we performed multi-instance score level fusion.

## Results and Discussions

We could see that PCA had least accuracy of 0.788 (Figure 1, Table 1) as the number of components increased the area under ROC decreased, because of noisy components. LDA gave 0.976 (Figure 1, Table 1), the best of accuracy and among the fusion rules, maximum rule gave 0.961 (Figure 1, Table 1). In experiment B, AUC for PCA (with multi instance fusion) gave the best accuracy of 0.986 (Figure 2, Table 2) and the least accuracy was given by LDA (without multi instance) which is 0.771 (Figure 2, Table 2). We could tell that the performance of PCA was better than LDA after implementing multi instance fusion.

## Conclusion

In this paper, we have implemented Face recognition using PCA and LDA fusion techniques to get better accuracy. We observed that maximum rule for PCA and LDA combination gave the best accuracy among all the three fusion techniques. As we have observed that LDA is a good classifier when coupled with PCA gave increased AUC. From Experiment B, we observed that PCA with multi instance fusion gave better accuracy than LDA. The data set what we use only had 40 subjects but in real time we may have many subjects, thereby resulting in lesser accuracy. So, the conclusions what we drew would hold good for this dataset only.

## References:

- 1) Alpaydin, Introduction to machine Learning, 3<sup>rd</sup> edition, MIT press, 2014
- 2) Jaafar, Haryati, and Dzati Athiar Ramli. "A review of multibiometric system with fusion strategies and weighting factor." *International Journal of Computer Science Engineering (IJCSE)* 2.4 (2013): 158-165.
- 3) M. Parviz, and M.S. Moin, "Boosting Approach for Score Level Fusion In Multimodal Biometrics Based On AUC Maximization", *Journal of Information Hiding and Multimedia Signal Processing*, Vol. 2, No.1, 2011, pp. 51-60.

## Appendices:

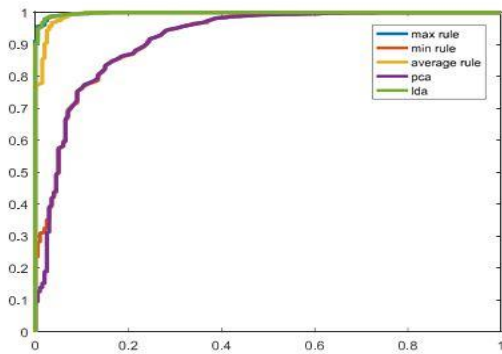


Fig1. 5 roc curves of performance of PCA, LDA, MCS

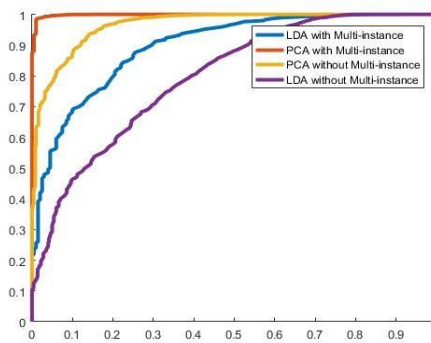


Fig2. 4 roc curves of PCA, LDA with & without multi instance

Table 1. Performance metrics for PCA, LDA and Multi Classifier System

Rule	Classifier	EER	AUC
PCA only	PCA	0.0152	0.788
LDA only	LDA	0.0290	0.976
Min	PCA+LDA	0.0312	0.766
Max	PCA+LDA	0.0563	0.961
Average	PCA+LDA	0.0341	0.934

Table 2. Performance metrics for PCA and LDA (with and without multi instance fusion)

Method	Classifier	EER	AUC
LDA- Multi instance	LDA	0.0231	0.871
PCA- Multi instance	PCA	0.0137	0.986
LDA-Without Multi	LDA	0.0156	0.771
PCA- Without Multi	PCA	0.0331	0.912