Recognition Using Class Specific Linear Projection

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Introduction

There are many face recognition algorithms proposed in the last few decades. Each algorithm has it's own advantages and disadvantages. In our class, we discussed a technique Principal Component Analysis (PCA) where we choose projections which maximises the variance or scatter along those directions which lead to dimensionality reduction. Here are some of the problems faced by any face recognition algorithm

- Pose Variation
- Illumination Variation
- Expression Variation
- Rotation, scaling, translation etc

In this project we have considered datasets where the images in the training set corresponding to the same class vary in facial expression and pose. We study an algorithm called Linear Discriminant Analysis (LDA) and is sometimes called Fisher Discriminant Analysis (FDA) where we choose projections which maximises between-class (same person or same face) variation while minimising within-class variation. We can observe that LDA uses the information of same class images compared to PCA.

Code Overview

We have used MATLAB software for this project. A model has been built using the 'Leave One Out' validation and the basic method used to predict the face output against the model is 'k-nearest neighbors' classification for which the file knn.m is used. The files pca.m and lda.m do the Principal Component Analysis(PCA) and Linear Discriminant Analysis(LDA) respectively. The file eigenfaces.m performs a PCA on the input data and stores k principal components. Similarly, the file fisherfaces.m performs a LDA on the input data and stores k principal components. In both cases, we have taken different values of k and plotted the error rate against it. eigenfaces_predict.m and fisherfaces_predict.m functions predict the face class on the basis of knn classifier.

Outcome of the Project

Recognised faces using a face dataset available online-yalefaces. We found that the fisherfaces method gives better accuracy than the eigenfaces method in cases where the training set has faces which vary in facial expressions. This conclusion agrees with previously published results.

Learning from the Project

The project gave us an insight into the technique of training and learning from a model to predict the output of a new test case. We learnt how to implement leave one out validation and k nearest neighbors for prediction. LDA exploits the similarity in individual classes to make the prediction process more efficient when compared to PCA.

Future Work

The project could be expanded to detection of faces and prediction in cases of illumination variation, scaling, etc. One can also try for face recognition when person is wearing spectacles, ornaments, etc.