Pattern Recognition - Project 2
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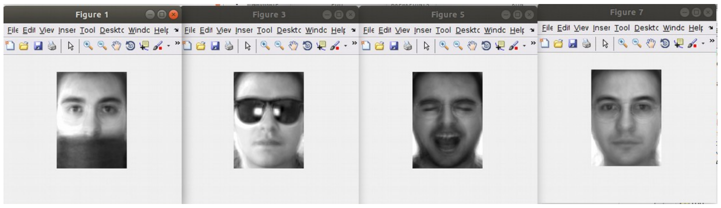
Problem 1,2,3)

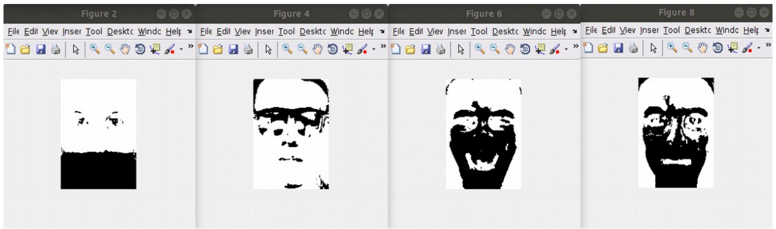
For the first three problem the procedure is same,

I created the dataset from **AR_Database**. I took **four class**, they are **normal expression** (AR_1), **laugh** (AR_4), **Cooling glass** (AR_10) and **Scarf** (AR_13). Corresponding label are also generated.

- 1) **PCA** subspace is then generated and the vectors from that subspace are the transformed to original dimension (to generate new images). Other than this, I also tried to use single vector to reconstruct the images and found that just a single vector can use to reconstruct the principal feature of the class. The result are shown below,



The images are got from PCA subspace. I have displayed the first image of the **four classes** that I have selected. We can clearly see that see that the **generated images** are **different** for each classes.



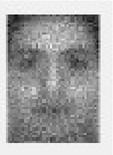
I also tried to use single vector from PCA subspace and see what it can generate. It was found that, the **single vector** was able to generate the principal features such as **scarf, cooling glass, laughing face and normal face.**

For **ICA and LDA**, the image size was reduced to 50*36 pixels (for faster computation). Hence, the images are slightly poor)

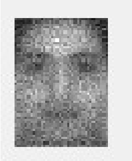
- 2) Similar to PCA, but here I used **kICA** (kurtosis-ICA) and **fastICA**. I also compared the reconstructed image and found that **kICA performed better than fastICA**. (Feature corresponding to cooling glass was **better** with **kICA**) But the **results were not as same as PCA** (this is because, ICA is generally used for more independent features, in my case, most of the facial feature are same. Thus, for similar datatype ICA might not be a better solution) Result are shown below.

This are the few sample generate from ICA subspace. We can clearly see that ICA was able to extract the **features like scarf and cooling glass**. Further comparison between kICA and Fast ICA is shown at the end

- 3) For **LDA**, I used all the classes and found **LDA** space using the function mylda(…). It computes transformation matrices namely **WPCA (from original to PCA)** and **WLDA (from PCA to LDA)**. I used the reverse transformation of each to reconstruct the images **(LDA → PCA → Original).** I tried LDA for ten dimension and the results are as follows. The images quality is poor because I reduced the size for faster computation in matlab.



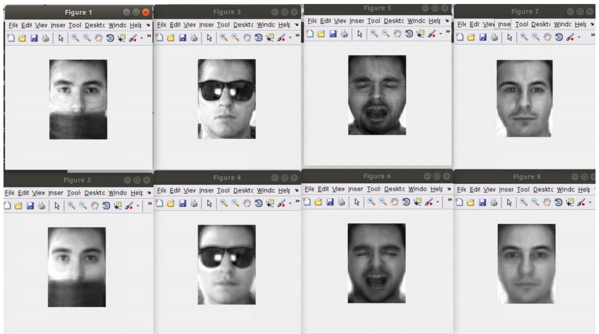
… …(other reconstructed images)… ...



4) For this part, I used PCA method to solve the issue, (Computed the mean and covariance matrix of the subspace and used the generated subspace in place of actual subspace) i.e. I found the correlation of the vector of the subspace(a) and used the generated subspace(b) to represent the actual subspace(a). It was found that, the generated PCA subspace can be used instead of actual subspace(a) but it might lead addition error due to variance associated with the vectors in subspace (a). The results are shown below.

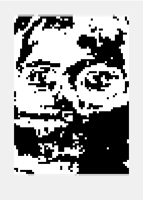
Comparison

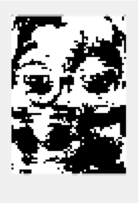
a) PCA



We can infer that one can reconstruct images from the subspace using the correlation of vectors in that subspace (by using PCA). Here, we are applying **PCA over PCA**, it is more like dimensionality reduction. Thus we are getting more blurred images. i.e. images with **lesser dimension (features)**

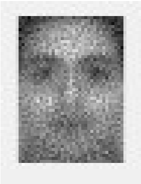
b) ICA





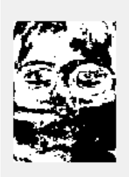
The first image with ICA alone and second is by using PCA. We can see that, the second image also has the features as that of first image. But when we look at the eyes, we can see that, second image has some features of cooling glass. i.e. **while apply PCA** though we are able to reconstruct the images, **we have actually lost few features** in this transformation.

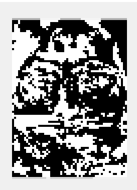
c) LDA



The first image is generate using LDA and second is by using PCA. It can clearly seen that **we have lost most of the data**. But still, over all we have got the facial feature. In this case, we can using this technique only for if we want to check whether it is a face or not. We can not use this in case of identifying that person, as we have most significant features in this transformation.

Others comparisons





This is the **comparison between kICA and FastICA.** We can clearly see the in first image (kICA) than the second (fastICA). Thus, in our case, kICA can be a better option.