Stats M231 Project 1

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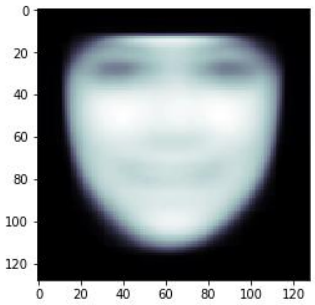
Part 1: ASM and AAM model for face recognition.

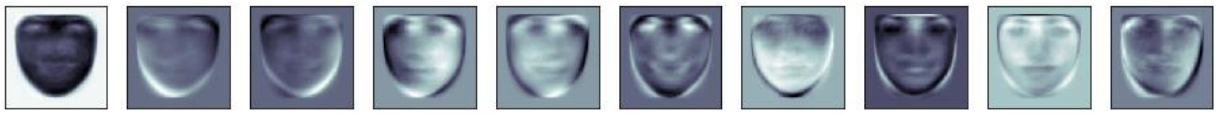
1. PCA: a linear method

   1.1

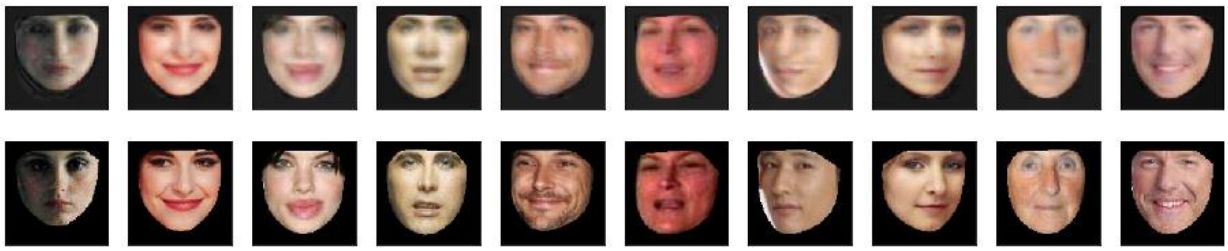
   We compute the mean for the training images with no landmark alignment and plot it below.



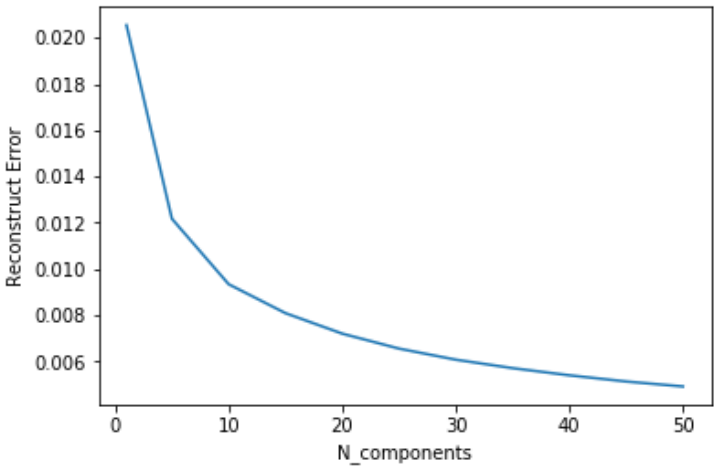
   After doing PCA on the V channel of the training images, we get the first 50 eigen-faces. Here we display the first 10 eigen-faces.



   Based on the first 50 eigen-faces calculated, we reconstruct faces in the testing set. In the figure below, the first line is 10 reconstructed faces and the second line is the corresponding original faces.

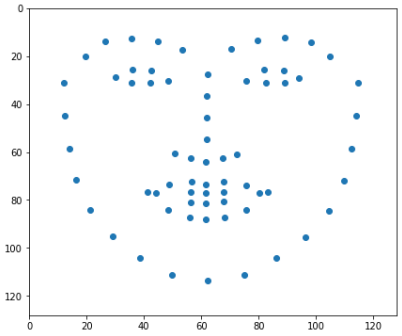


   When we calculate the total reconstruction error per pixel, we only consider the V channel here. The following plots shows how reconstruction error changes when we change the number of eigen-faces.

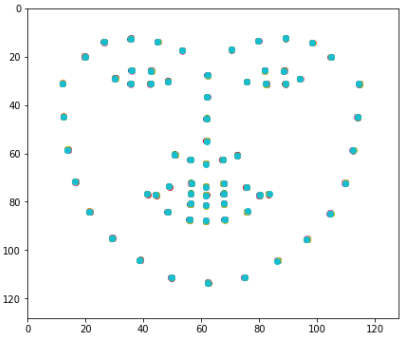


1.2

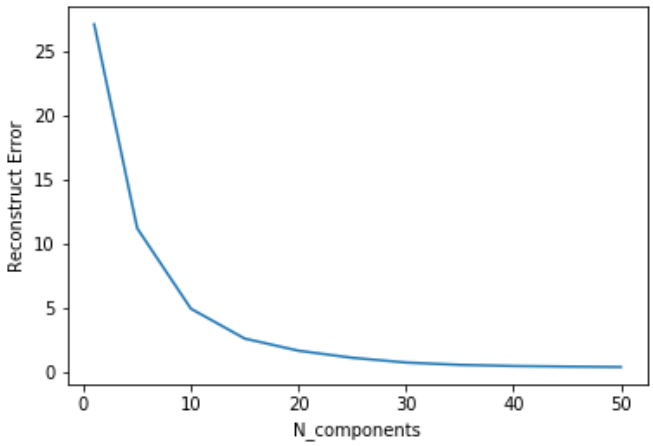
We compute the mean for the training landmarks and plot it below.



After doing PCA on the landmarks of the training images, we get the first 50 eigen-warpings. Here we display the first 10 eigen-warpings. These 10 eigen-warpings seem to be overlapped.



Based on the first 10 eigen-warpings calculated, we reconstruct landmarks for the testing faces. When we calculate the reconstruction error, we calculate the average distance between the reconstructed landmarks and the original ones. The following plots shows how reconstruction error changes when we change the number of eigen-warpings.

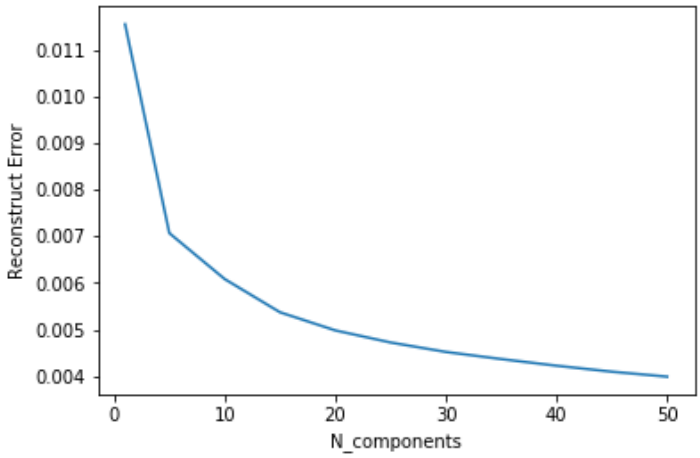


1.3

In this part, we combine the two steps above. 20 reconstructed faces are plotted below.

Then we plot the corresponding original faces for comparison.

Next, we plot the reconstruction error per pixel against the number of eigen-faces below, like what we have done in the 1.1. This error seems to be smaller than the one in the 1.1.



1.4

The followings are 50 synthesized face images based on a random sampling of the landmarks and a random sampling of the appearance. We plot them in a gray scale.

2. Autoencoder: a non-linear method

2.1

After training auto-encoder, we get the training loss as follows.

```
Appear Training Epoch:298,Loss:0.002525
Appear Training Epoch:299,Loss:0.002525

Landmark Training Epoch:298,Loss:0.000421
Landmark Training Epoch:299,Loss:0.000421
```

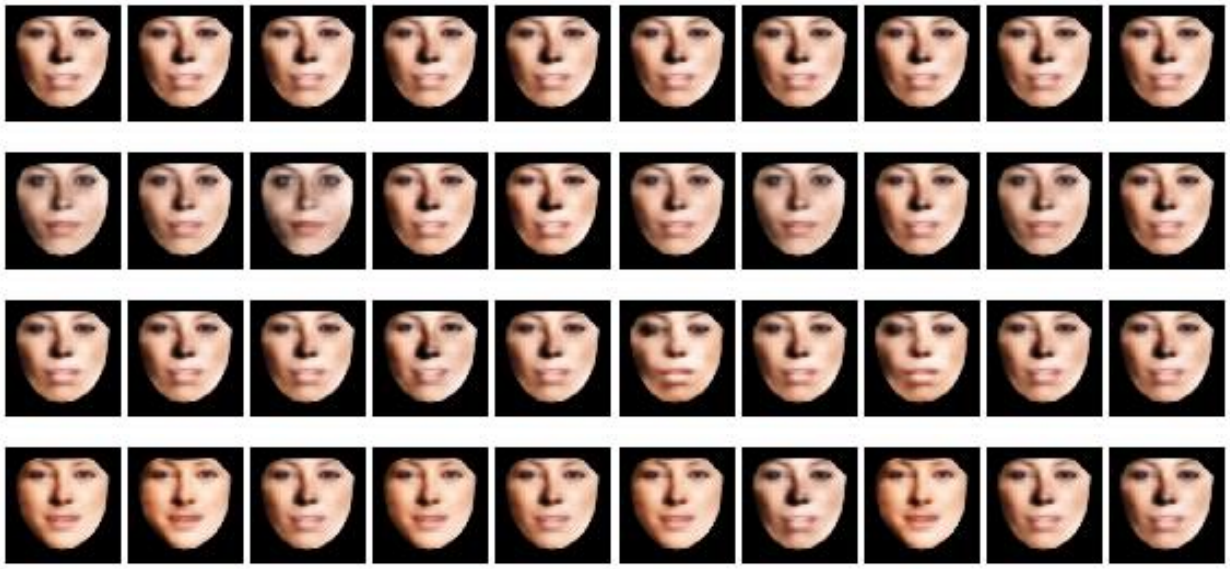
We re-perform the experiment in the 1.3 by replacing PCA with auto-encoder and plot 20 reconstructed faces below.

Also, we plot the corresponding original faces below for comparison.

2.2

For interpolation, we choose the face below as the original face. We use a random sample method in the interpolation process.

The following 4 lines shows the appearance interpolation by auto-encoder.

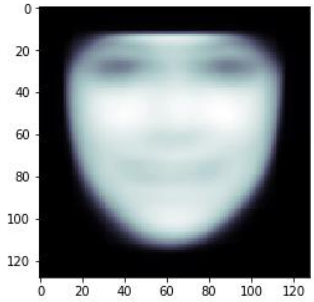


The following 2 lines shows the generated faces with geometric variances by auto-encoder.

Part 2: Fisher faces for gender discrimination.

3.1

The left one is the Fisher Face we get. When we add the Fisher Face to the mean, we get the right plot below.



We choose w_0 to be about 0.00058084 which is calculated by the training mean. The error rate we get is **12.5%.**

3.2

From the plot below, after projection to the 2D-feature space, the female and male images are separated but the result might be not good enough.