Digital Image Processing
(ECE513)

Computer Project 1: Image Transforms and Facial Eigen-Images

The goal of this computer assignment is to study PCA for the purpose of image data reduction and facial pattern representation and classification. The "Yalefaces" image database (see course web page under Images) is used for this assignment.

1. PCA is used here for facial pattern representation using the algorithm covered in Lecture 14. The small Yale face database yalefaces.zip in folder Images contains 165 images of 15 subjects taken under 11 different conditions (center, glasses, sad, happy, sleepy, etc.). The "Extended Yale Database B" which contains 16128 images of 28 subjects http://vision.ucsd.edu/~leekc/ExtYaleDatabase/ExtYaleB.html provides the coordinates of the face features in each image apart from the image itself. This can be used for centering the face image. Note: A MATLAB code is provided to accomplish this centering operation.

   First, start by choosing only 15 training images (same condition or pose) and train the PCA-based system by finding the eigen-images. Test the quality of the reconstruction on some randomly picked training samples using only the most dominant PC's and display the results. Comment on the reconstruction ability both visually and using SNR measure. Test the reconstruction ability of the trained system on some randomly picked (at least 4) test cases (remainder of data not used for training) and comment on the results. Then, expand your training set to include 2/3 of the data set and keep the rest as testing set. Repeat the same process on these expanded data sets. You should also try to test the capabilities of this trained system on a new face (e.g., yours) taken under similar conditions.

2. Bonus (20pts): Design a minimum distance classifier to classify the facial patterns using their PC's. You can choose the particular classes of interest e.g., female and male or happy and sad, etc.

3. Provide a detailed discussion on the effectiveness of this transform for image data reduction and facial representation and recognition in a report. **Please read the guidelines for preparing your report.**