

Homework 2

BIOM 693: Advanced Biometrics

Instructor: Dr. Arun Ross

Due Date: April 7, 2009

Note: You are permitted to discuss the following questions with others in the class. However, you *must* write up your *own* solutions to these questions. Any indication to the contrary will be considered an act of academic dishonesty. Code developed as part of this assignment should be placed in a zip file and sent via email to arun.ross at mail.wvu.edu with the subject line “biom693: Homework 2”. A hard-copy of the assignment should be submitted in class prior to the lecture on April 7.

1. [20 points] The two critical steps of a mosaicing algorithm are image registration and blending. In the [reading list](#) for fingerprint mosaicing there are five different papers listed (excluding Burt and Adelson’s general paper on mosaicing). (a) Choose any three papers and describe the *registration* and *blending* procedures used in each of them. (b) List five benefits of fingerprint mosaicing.
2. [25 points]
 - (a) Write a program that implements the line-based RANSAC algorithm to determine the transformation parameters relating two sets of minutiae points. The input to your program will be two text files, M_1 and M_2 , containing the minutiae coordinates of two fingerprint images. The output of your program should be (a) the translational and rotational parameters, (t_x, t_y, t_θ) , relating the two minutiae sets M_1 and M_2 , and (b) a match score, s , computed as $s = \frac{100p^2}{n_1 n_2}$, where p is the number of corresponding points between the two minutiae sets (use a bounding circle of radius 10 units), and n_1 and n_2 are the number of minutiae points in M_1 and M_2 , respectively. Hint: You do not have to consider all possible line pairings between the two fingerprint images. Eliminate those line pairs whose orientations differ by an angle more than 30° and whose lengths differ by a scale greater than 1.25.
 - (b) You are given a database of 80 fingerprint images and the associated minutiae points: [\[click here for data\]](#). This information corresponds to 10 different fingers (8 impressions per finger). Use the program developed above to determine the transformation parameters and match scores between every pair of images. Generate the ROC curve and report the EER and d-prime values for this experiment.
3. [25 points] Develop a face recognition software that utilizes LDA-coefficients to represent and match facial images. You are given a set of 500 face images pertaining to 50 different subjects (10 images per subject) to test your matcher [\[click here for data\]](#).

- (a) Compute the fisher-faces (i.e., basis images) using all 500 face images.
 - (b) Select the top 50 fisher-faces and compute the LDA-coefficients of all the images in the dataset. Plot the ROC curve summarizing the matching performance using these coefficients. What are the EER and d-prime values of the matcher?
 - (c) Repeat part (b) by selecting the top 10, 20, 30 and 40 fisher-faces. How does the performance of the matcher vary as a function of the number of fisher-faces used?
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