CSE252 – Computer Vision – Assignment #3

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`http://www-cse.ucsd.edu/~sjb/classes/sp02/cse252`

Target Due Date: Tue. May. 14, 2002.

1. For this problem, download the script `make_P_pointset.m` from the course web page and run it to produce the pair of pointsets shown in class. (It should look like a pair of P's.)

   (a) Implement the correspondence algorithm of Scott and Longuet-Higgins (1991) and use it to match the pair of pointsets. Show the correspondences by drawing a line segment between each pair of corresponding points. Experiment with different values of σ and discuss how this affects the result.

   (b) Repeat the preceding step by solving the minimum cost weighted bipartite matching problem (also known as the linear assignment problem) where the cost matrix is given by the pairwise squared Euclidean distance. For this problem you are free to use the implementation of the Hungarian algorithm on the class web page (`hungarian.m`).

2. This problem uses the script `make_test_image.m` from the class web page, which produces an image (call it I) like the one in Fig. 13(a) of Freeman and Adelson (1991).

   (a) Experiment with the Canny edge detector on I and display the output for several different choices of σ.

   Matlab hints: `edge(...,'canny')`.

   (b) Construct and display the G_2-H_2 quadrature filterbank shown in Fig. 5 (a) and (d) of Freeman and Adelson (1991). Use a meshgrid of size 21×21 and a Gaussian with $\sigma^2 = 10$. L_1-normalize each kernel.

   Matlab hints: `hilbert`, `imrotate(...,'bilinear')`.

   (c) Apply this filterbank to I and display the output of each filter. Also display the quadrature energy E and phase φ for the quadrature pair oriented at $\theta = 0°$. Provide a brief explanation of what you observe in each of these images.

   Matlab hints: `conv2(...,'same')`, `angle`.

   (d) Implement the pseudoinverse-based reconstruction method of Jones and Malik (1992) using the above filterbank. Use it to show the reconstruction of the 21×21 neighborhoods centered on several selected points on I (e.g. pixels on or near corners or lines, etc.).

   Matlab hints: `pinv` and/or `svd`.

3. To do this problem you will need to download images from the USC-SIPI Image Database (`http://sipi.usc.edu/services/database/`).

   (a) Select and download four Brodatz textures of your choice. Crop two 128×128 windows from each image, one for training, one for testing. Apply the filterbank from the previous problem to each image window and display the resulting filtered images.

   Matlab hints: `imcrop`, `getrect`.

   (b) Compute and display the following quantities for each filtered image: mean, variance, and normalized histogram. (Crop the borders first to remove boundary effects.) Use 15 equally spaced bins centered around zero for the histogram, and make sure that the bin definitions are the same in each case.

   Matlab hints: `hist`, `subplot`, `bar`.

   (c) Compute the average χ^2 distance between the marginal histograms of filter outputs from each testing window to each training window. Display the result in a 4×4 table, and indicate the minimum distance in each case.