EE257/GP258 **Lab/Homework #3**
Applied Optimization Laboratory Handout #9
Due: Thurs., Jan. 31

Problem 1 – Singular value decomposition.

Filter the data from problems 3 and 4 in the week 2 assignment using singular value decomposition. To begin, download the data file lab3prob1.dat from the web site. This is the same data file we used previously.

To compute the eigenvectors, you can use the supplied code eigen.f from the web page. The routine is called as

call eigen(isize, marix, eigenvalues, eigenvectors)

which works for square matrices. Isize is the matrix dimension. The routine returns the eigenvalues in descending order in a vector eigenvalues, and the eigenvectors appear as columns in the marix eigenvectors.

For the matrix A in Ax=y, use the same 15 kernels we used last week. The A matrix then is dimensioned 15 x 100.

i. First, plot the solution using all 15 eigenvalues/vectors.

ii. Now, experiment with differing numbers of eigenvalues, and choose the minimum number of eigenvalues that yields a physically plausible spectrum. Plot this result and turn it in.

iii. Comment on how well the method preserves the magnitude of the spectrum as compared to constrained linear inversion using both minimum power and maximum smoothness constraints.

Problem 2 – Image stretching and display.

The web page presents 4 data files, stanfordr.1024, stanfordg.1024, stanfordb.1024, and stanfordir.1024. Each is a 1024 x 1024 image of the Stanford area acquired by an orbiting satellite in r, g, b, and ir parts of the spectrum. If you display these, you will see that they do not show much contrast.

i. Process each of these four data files to produce images that better fit the computer display, with means of 140 and standard deviations of 60. Turn in the resulting byte files.

ii. Combine the r, g, and b images for a “natural” image of the area and turn in as tiff images. Use your enhanced versions of the images to do this.

iv. Produce a false color image where the ir channel is displayed as red, the r channel is displayed as green, and the g channel is displayed as b. Turn in this false color image. Comment on what you can readily see in this display.

Problem 3 – Principal components

Use principal components analysis on the four data channel from problem 2 to create an image of the three principal components of the data. Create a well-stretched version of the data (mean = 140, standard deviation = 60) into an rgb image, and turn in.

How does the principal components analysis affect your ability to see subtle variations in color and discriminate objects in the image?