

**Image Compression and Packet Video**  
**September 13, 1999**  
**Laboratory Assignment #1**  
**Dr. Nicholas Beser**  
**e-mail: Nicholas.Beser@ jhuapl.edu**

Purpose:

This lab achieves several functions:

1. The lab introduces the student to MATLAB
2. The lab provides an introduction to the image processing toolbox
3. The lab provides an introduction to guide, the MATLAB GUI building tool
4. The lab provides an opportunity to expand the performance measures section by adding several image metric routines from Paul Fisher's paper.

Problem:

Several test images have been loaded into the system. These are TIF files, (256x256x8 pixel) images that have been compressed and reconstructed using two different programs, and different ratios of compression. The lab project will develop a tool that will analyze the images by displaying and calculating various statistics. In addition, the MATLAB program will ask the user for input to control what operation is performed. The program will also perform several image from the image processing toolbox.

Note: You can also download these images from the class web site:

<http://aplcnmp.apl.jhu.edu/Notes/Beser/525759>

The program should:

- Ask for the original image
- Ask for the reconstructed image
- Under GUI control, ask for the following operations
  - Display the original image
  - Display the reconstructed image
  - Compute and display:
  - Scaled/Offset difference image using the following equation:

$$\text{Difference Pixel } g(i, j) = 2[f(i, j) - \hat{f}(i, j)] + 128$$

Remember to clip the maximum value to 255 and minimum value to 0.

- Histogram of Original Image
- Histogram of Reconstructed Image
- MSE (Mean Squared Error)

$$MSE = \frac{1}{N_x * N_y} \sum_{i=1}^{N_x} \sum_{j=1}^{N_y} [f(i, j) - \hat{f}(i, j)]^2$$

where  $N_X$  is the Number of pixels in the rows, and  $N_Y$  is the number of pixels in the columns.

- RMSE (Root Mean Squared Error)

$$RMSE = \sqrt{\frac{1}{N_X * N_Y} \sum_{i=1}^{N_X} \sum_{j=1}^{N_Y} [f(i, j) - \hat{f}(i, j)]^2}$$

- PSNR (Power Signal to Noise Ratio)

$$PSNR = 20 \log_{10} \left( \frac{255}{RMSE} \right)$$

- Perform image enhancement and filtering. You want to be able to reload the image prior to each filter.
  - Compute a histogram equalize of the original and reconstructed image. Display the result.
  - Compute a filter of the original image using the Wiener Filter function, with the arguments [3 3] .(Type help wiener2 from the MATLAB command window).
  - Adjust the color map of the original image using the brighten(beta) function. The Image Processing Toolbox function will make a darker or lighter map depending on the value of beta.

hint: MATLAB contains a GUI language. MATLAB version 5 contains a program called guide. (You run guide from within MATLAB). With guide, you can paint the GUI interface, and then save the files for editing with MATLAB. The code to support all of the Lab 1 functions can be dropped into these routines. Consult the “Building GUIs with MATLAB” included on your MATLAB CD-ROM.

Extra Credit:

Copies of the paper “A Survey of Quality Measures For Gray Scale Image Compression” by Ahmet Eskicioglu and Paul Fisher (Computing In Aerospace 9 Conference, October 1993) were handed out in class. This paper provides the equations for a large number of image metrics. Implement metrics I through XIV (1 through 14). You can either include them as a menu item, or as a special screen.