**Lab/Homework #6**

Problem 1 - Convolutional operations.

Download the file lab6prob1data from the course website. The line length is 580 bytes.

*Noise Reduction:*

1. Display the image. Filter the images using the matlab function 'conv2' and masks of all ones of size 2x2 and 3x3, and print/submit (write your own code to calculate the convolution and compare with the matlab conv2 function). How does the size of the mask affect blurring and noise reduction? Which do you think provides a better tradeoff between blurring and noise reduction for this image?

1. "Sharpen" the 3x3 blurred image by convolving with the Laplacian mask

* 1. -1 0
  2. 5 -1

0 -1 0

Display and submit. Does this operation reduce the blurring? What about the original noise? You might need to rescale this image after convolving to make the effect more visible and to make the contrast more pleasing (write your own function to stretch the image automatically).

1. Apply a second sharpening step as in (ii). Display and submit. Would repeated sharpening help image interpretation? Again, rescaling will be needed to see the effect.

*Zoom:*

1. Zoom one of these images by a factor of two using the first-order hold code you developed in a previous homework, and also with convolutional methods (hint). Display and submit.

1. Calculate a second order hold matrix by convolving the zero order hold matrix with that for the first order hold. Zoom an image of your choice using the second order hold. Display and submit.

Problem 2 - Shot noise.

Download the file lab6prob2data from the course website. The line length is 256 bytes. Examine the image and note the presence of shot noise.

1. Convolve with a box filter (all ones) to reduce the noise. Select a reasonable filter size to trade off noise and blurring. Display and submit.

1. Now apply a 3 x 3 median filter to the image and compare the result with the convolutional filter (write your own code to perform the median filter). Display and submit. Which approach is more satisfying in terms of image quality?

Problem 3 – Experimenting with Filters

Experiment and design your own filter (or modify an existing one we’ve discussed in class). Demonstrate your filter with an image of your choice. In a few sentences, explain why/how you designed this filter and what it seems to do. For inspiration, you might do some research on other filters we haven’t discussed in class, or checkout this interesting website that lets you quickly visualize different convolutional filters:

<http://setosa.io/ev/image-kernels/>

Problem 4 - Power spectrum.

1. Copy the sequence lab6prob5data from the class directory. This is an ascii file, not a binary file. Read it into an array and plot -- it is a 1-D array only, not an image.

1. Calculate the Fourier coefficients of this sequence assuming it repeats exactly, up to a frequency of 20 cycles per period shown. Plot the coefficients as a function of frequency.