CSE166 – Image Processing – Homework #3

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`http://www-cse.ucsd.edu/classes/fa05/cse166`

Due (in class) 11:00am Thursday Oct. 20, 2005.

Reading

- GW 4.3-4.4, 4.6.

General Homework Guidelines

- Use the Cover Sheet provided.
- Please attach all code that you use. Attach code at end of submission.
- In general try to keep your answers concise. Use as many words as you need and no more. Also work on your presentation skills. This means organize your plots and displays. Always use titles and add captions when appropriate. *Points will be awarded for clarity and presentation.*

Written exercises

1. GW, Problem 4.2.
2. GW, Problem 4.7.
3. GW, Problem 4.8.
4. GW, Problem 4.10.
5. GW, Problem 4.15.
6. GW, Problem 4.18.

Matlab exercises

1. Filtered Noise

   (a) Consider the filter with Fourier transform

   $$H(u,v) = \frac{1}{u^2 + v^2}$$

   on the interval $[-127, 128] \times [-127, 128]$. This is known as a $1/f^2$ transfer function. Since it blows up at the origin, replace that value with zero. Apply this filter to a 256×256 image of normally distributed random noise (use `randn`). For practical reasons, it is best to perform this operation in the frequency domain. Hint: you will need to use `meshgrid`, `fft2`, `ifft2`, and `fftshift`. Also, due to numerical error, you will need to use `real` to look at the real part of the filtered image in the spatial domain.

   (b) Display the filtered image along with the original noise image. Quite remarkably, the filtered image should look like a "natural" texture, such as clouds or terrain. What does this suggest about the statistics of natural images vs. that of images of manmade objects?

   Things to turn in:

   - Code listing for part 1a.
   - Printout and written answer for part 1b.

2. Filtering in the Frequency Domain

   Before doing this exercise, review GW Sections 4.6.3 and 4.6.4 to learn about frequency domain filtering, zero-padding, and the relationship between correlation and convolution.

   (a) Write an m-file to reproduce Figure 4.41(a-f) using Frequency domain filtering. Note: the Matlab command for the complex conjugate is `conj`.

   (b) Repeat the previous step using operations in the spatial domain and show that the results are the same. Hint: use `conv2` and `rot90`.

   Things to turn in:

   - Code listing for parts 2a and 2b.
   - Printouts of program output for parts 2a and 2b.