Homework 4
Due - 10/23 @ 1530

Digital Image Processing

ECE 4501/6782

Instructions: ***Please submit 1 PDF document with your answers****. Handwritten notes can be scanned with apps such as CamScanner. Typing the answers out is recommended, wherever possible.* ***Include any code if attempted.*** *Assume that you can use MATLAB/Python functions wherever it is not mentioned EXPLICITLY to build your own.*

Learning Objectives

1. *Designing basic low pass,band pass, and high pass filters for images with varying cutoff frequencies.*
2. *Reconstructing a blurred image utilizing Deconvolution.*

Question 1 *30 points*

Load the images ‘pebbles.jpg’, ‘pattern.jpg’ and ‘bricks.jpg’ into your workspace. Perform the following operations:

1) Design a Low Pass filter with a suitable radial cutoff frequency(user defined). Display results post filtering for each of the 3 images.

2) Design a Band Pass filter with a suitable radial frequency range(user defined). Display results post filtering for each of the 3 images.

3) Design a High Pass filter with a suitable radial cutoff frequency(user defined). Display results post filtering for each of the 3 images.

Please write a function for each case which takes the image, and user defined cutoff frequency as an input, and displays the filtered result as an output.

Hint : Radial frequency implies you got to think about masks.

Question 2 *20 points*

Fun with deconvolution!

You are given the file ‘mystery.mat’. It contains a 128x128 image called ‘mystery’. It has been blurred with an average filter of unknown width as follows:

i. I started with an image of 128x128 zeros and embedded in the upper left corner an average filter. Kernel = zeros(128, 128); Kernel(1:width, 1:width) = 1/(width * width);

ii. I took the DFT of this kernel and multiplied with the DFT of the mystery image. The inverse DFT of the product is your mystery image.

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Answer the following

a. What type of operation is the one described in (ii)?
b. The DFT of the mystery image
c. The deconvolution (restored version) of the mystery image (What was the original size of the average kernel?)
d. The DFTs of the restored image and of the average kernel.
e. (Bonus) Who is in the mystery picture? - *2 points worth here*