Assign 3

Deadline : 25th Oct, Tue, 5PM.

You should submit the write-up with Matlab generated images being reported.

Q1.a. Derive the 2D frequency domain Laplacian filter using the DFT property for differentiation (see Tables in Textbook). You can start with CTFT, differentiate and obtain expression in terms of frequency in Hz ie $\mu 1$ and $\mu 2$. The discrete approximation of this filter can be obtained by replacing $\mu 1$ and $\mu 2$ with discrete frequency indices *k* and *l*. This is also given in the lpfilter.m file in folder LectCodesCh4. [15]

b. Use this file and plot the centered magnitude response. As it is of high pass nature, you should observe black at center and white as you move towards corners. Report this image. [10]

Q2. a. Which Laplacian kernel does file laplacianfilter.m in LectCodesCh4 implement? [5]

b. In the same file obtain the values of matrix 'hp' such that it implement Laplacian kernel for H+V+D. Note 'g' gives Laplacian filtered image, 'gshar' gives sharpened image. Compare the results of H+V and H+V+D sharpened images and comment on the sharpness of the two images. Report the images. [10]

Q3. Consider spatialviafft.m file. Instead of average filter, use 'motion' filter of size 1x7. Put value of parameter theta = 0. Variable 'j' is obtained through frequency domain filtering. [15]

Variable 'r' is obtained through direct convolution. You must obtain the motion filtered image through both ways ie filtering via FFT and direct convolution ie both 'j' and 'r'. Report the images obtained. Now take only 'j(1:M,1:N)', MxN being size of original image. Compute the max and min difference between 'r' and 'j(1:M,1:N)'. You must observe that this difference does not exceed 0.5 in magnitude. This is because you should get similar results through both operations. And the difference would arise only due to round off errors. Report the images.

Q4. Assume a hypothetical scenario where image formation model is $\int_0^T f(t,z)e^{-(v_x+v_y)\tau}d\tau$. Find the degradation function H in terms of $v_x, v_y and\ T$. Symbols have their usual meaning. [15]

Q5. An image is convolved with an ideal low pass filter. The resultant image is convolved with a Gaussian low pass filter to obtain a final image. Will you observe ringing effect in the final image. Give reasons. [10]

Q6. Why or why not an inverse filtering ie $\hat{F}(k,l) = \frac{G(k,l)}{H(k,l)}$ gives a good restored image? [10]

Q7. Compute 4 point DFT of f(x) = {0 1 2 3}. Show calculations. [10]