EE 512 – Digital Image Processing
Assignment 4

Issued on: Oct. 30, 2020 Marks: 100

Submission Instructions:

- Due date is **Friday, 6th November** by **9:00 p.m**. Submission is to be made on LMS. No late submissions allowed.
- If a question requires programming, then make sure a separate **.m* file is present for each question. *Eg.* Q2.m, Q3.m and so on.
- All processed images should be saved as JPEG or PNG and submitted.
- A **written report** is mandatory. This should contain your solutions for any written or mathematical questions as well as discussions of results or processed images.
- The assignment has to be done individually. Plagiarism policy applies.

Questions:

You may **not** use any functions from the image processing toolbox, including but not limited to: fft2(), ifft2(), xcorr2(), normxcorr2()

You might find the built-in matrix flipping and rotation functions useful for this assignment.

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1. Write a function in MATLAB 'myDFT' to compute DFT of an input image. Such a function can be easily written using for loops, but that will be very slow. Therefore, your function should be implemented using matrix multiplications instead.
   Hint: Use separability property of the DFT and derive two matrices that should be pre and post multiplied to the image.
   Use your function to compute DFT of *'cman.pgm'*. Your results should include both the log of the magnitude and the phase image.
2. Inverse DFT can be computed from the DFT without the need to write another function from scratch. Write a function 'myIDFT' that computes the IDFT without explicitly using the inverse DFT equation. Instead, your function should use the 'myDFT' function you made in the previous question.
   Run this function on the output from the previous question and submit the resulting image in your report.
3. Write a function 'myFreqConv' which takes an image and a convolution mask as input, and returns the convolution result. This function should use your 'myDFT' and 'myIDFT' functions.
   Use this function to filter *'cman.pgm'* with the following mask

$$\begin{bmatrix} -1 & 0 & -1 \\ -1 & 0 & -1 \\ -1 & 0 & -1 \end{bmatrix}$$

Compare the result with your result from Q1.b of Assignment 3.

4. Apply the low-pass ideal, Butterworth (order 2) and Gaussian with cut-off frequency of 30 on 'filtering.tif'. Compare and comment on the results (Use the figures in the book as a guide of what your result should be).
5. You are given an image 'degradation.tif', that has been corrupted with additive Gaussian noise. Apply arithmetic and geometric mean filters of size 3×3. Compare and comment on the results.