

EE 512 – Digital Image Processing

Assignment 3

Issued on: Oct. 21, 2020

Marks: 100

Submission Instructions:

- Due date is **Thursday, 29th October** 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:

`conv2()`

1.

- Write a function in MATLAB that will take two inputs, an image and a square mask, and return an image of the same size as the original which would be the result of convolving the mask with the input image.

For simplicity assume that the mask can only have odd numbered dimensions so the center neatly lies on a single pixel. Also notice that the output image should be the same size as the input so you will have to implement some form of 'padding'.

- Use your function to apply the following 4 masks on '*cman_smal.pgm*'. Comment on the effect of each mask in your report.

$$\begin{bmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix} \begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix} \frac{1}{96} \begin{bmatrix} 0 & 1 & 2 & 1 & 0 \\ 1 & 6 & 10 & 6 & 1 \\ 2 & 10 & 16 & 10 & 2 \\ 1 & 6 & 10 & 6 & 1 \\ 0 & 1 & 2 & 1 & 0 \end{bmatrix}$$

- Use your function to convolve the image with the following averaging filter.

$$\frac{1}{9} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

Now apply the same filter to the output of the above step. Comment on the result. What mask would have been needed to apply to get the answer in a single step? First derive the answer then verify it using your function.

If this mask would have been applied several times in succession, what would have been the net effect?

2. Implement a 3×3 , 5×5 , 9×9 median filter and apply it on '*cman_small_saltnpepper.pgm*'. Comment on the results and compare the results with average filters of the same sizes.
Comment on the effect of applying a 3×3 median filter more than once on an image.
3. Decimate the image '*w.pgm*', atleast 3 times, using your function from Assignment 1. First without filtering then with filtering. Compare and comment on the results.
You can use the following filter:

$$\frac{1}{17} \begin{bmatrix} 1 & 2 & 1 \\ 2 & 5 & 2 \\ 1 & 2 & 1 \end{bmatrix}$$