CS555/455 Fall 2018

Assignment 2

(Due on October 4 by 11:59pm)

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I. Questions (46%):

(1) (10%) Given following four masks, order them in that generating smooth images from light smoothness to heavy smoothness, Explain why.

M1:

1 1 1
1 1 1 **heaviest**
1 1 1

M2:

1 2 1
2 4 2 **heavier smoothing**
1 2 1

M3:

0 1 0
1 4 1 **heavy smoothing**
0 1 0

M4:

0 0 0
0 1 0 **No(zero) smoothing (same image as input image)**
0 0 0

light to heavy smoothing is:

m4<m3<m2<m1

Difference between the center pixel and neighborhoods is more in M3 than M2. Hence, M3 is less smoothed than M2.In M1, center pixel is replace by the sum of 8 neighborhoods multiplied by 1/9.Which makes it most smoothed.In M4,there is no smoothing ..it is just the same image as that of original image.

(2) (8%) The filter for image enhancement can be designed by first-order derivatives and second-order derivatives. Compare the first-order derivatives and the second-order derivatives, which one is better for image enhancement. Explain why.

First order derivative produces thick edges and on the other hand second order prodeces thinner edges. Second-order derivatives have a stronger response to fine details, such as thin lines and isolated points. A second-order derivative is much more aggressive than a first-order derivative in enhancing sharp changes.Second order derivative is better for image enhancement.

(3) (8%) An edge image (E) is generated by filtering a gray scale image (I) by a Laplacian mask (M). The sharpening image can be obtained by simply adding the original image (I) and the edge image (E). Show a single mask (S) based on the mask M such that the image sharpening can be implemented with one pass of the single mask.

$$M = \begin{bmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

ANS:

$$\mathbf{S} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & -7 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

we know that ,

S=E+I , E = M*I

inserting E value in 1st equation,

S=M*I+I

(4) (8%) To extract edge information of an image, people can either

(a) Blur the image first, then apply edge detector
or

(b) Apply edge detector first, then do the image blurring.
Which way is better, explain why.

way (a) is better

Blurring the image first and then applying edge detector makes it less sensitive to noise. Applying edge detector first and then do the image blurring makes it more sensitive to noise

(5) (12%) Apply the median filter to remove the noises in the following image I:

4	4	4	4	4	4	4	4
4	4	4	48	4	4	4	4
4	4	64	64	64	64	4	4
4	17	64	64	96	64	4	4
4	4	64	85	64	64	8	4
4	4	64	64	64	64	4	4
4	56	4	4	23	4	4	4
4	4	4	4	4	4	4	4

(note: assume that all the pixels outside the image have value: 4)

(a) Use 3*3 square-shape median filter to filter image I, obtain image M1;

4	**4**	**4**	**4**	**4**	**4**	**4**	**4**
4	**4**	**4**	**4**	**4**	**4**	**4**	**4**
4	**4**	**48**	**64**	**64**	**4**	**4**	**4**
4	**4**	**64**	**64**	**64**	**64**	**4**	**4**
4	**4**	**64**	**64**	**64**	**64**	**4**	**4**
4	**4**	**56**	**64**	**64**	**23**	**4**	**4**
4	**4**	**4**	**4**	**4**	**4**	**4**	**4**
4	**4**	**4**	**4**	**4**	**4**	**4**	**4**

(b) Use 5*5 cross-shape median filter to filter image I, obtain image M2;

4	**4**	**4**	**4**	**4**	**4**	**4**	**4**
4	**4**	**4**	**4**	**4**	**4**	**4**	**4**
4	**4**	**64**	**64**	**64**	**64**	**4**	**4**
4	**4**	**64**	**64**	**64**	**64**	**4**	**4**
4	**4**	**64**	**64**	**64**	**64**	**4**	**4**
4	**4**	**64**	**64**	**64**	**64**	**4**	**4**
4	**4**	**4**	**4**	**4**	**4**	**4**	**4**
4	**4**	**4**	**4**	**4**	**4**	**4**	**4**

(c) Compare M1 and M2, indicate which filter is better, and explain why.

M1 is better than M2 as a cross shaped filter finds median through cross entities only.On the other hand,square shaped one takes median with the help of all surrounded entities.