

博士班基本學科考試：數位影像處理

2009年3月5日

1. (10%)

We have a 512×512 image, as shown in Fig. 1.1, the pixel value of (x,y) is represented by $I(x,y)$. (a) rotate the image 30 degree clockwise about the point $(x,y) = (0, 0)$, as shown in Fig 1.2, what is the intensity value of $(238,247)$ after rotation by using bilinear interpolation? (b) rotate the image 30 degree clockwise about the point $(x,y) = (255, 255)$, as shown in Fig 1.3, what is the intensity value of $(238,247)$ after rotation by using bilinear interpolation? Represent the answer by $I(\sqrt{3} = 1.732)$

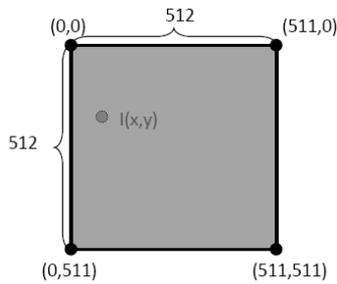


Fig.1.1

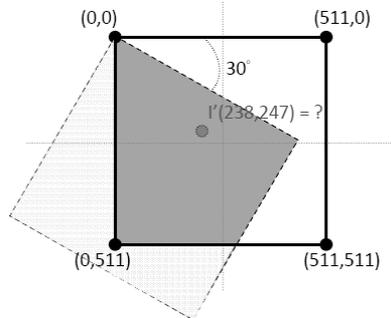


Fig.1.2

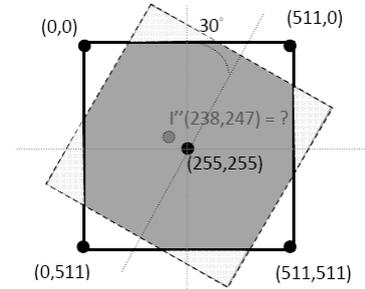


Fig.1.3

2. (20%)

Suppose that you apply a two-dimensional Laplacian spatial filter, i.e.

$$g(x, y) = [f(x+1, y) + f(x-1, y) + f(x, y+1) + f(x, y-1)] - 4f(x, y)$$

- (a) Find the equivalent filter $H(u, v)$ in the frequency domain.
- (b) Show that your result is a highpass filter.

3. (20%)

- (a) What is binary dilation and binary erosion? Write down their definitions.
- (b) Prove the validity of the duality expression $(A \bullet B)^c = (A^c \circ \hat{B})$. (Notice: If you want to use the duality of dilation and erosion, you will have to write down its proof.)

4. (20%)

The following image $I(x,y)$ of size $N \times N$ is corrupted by salt-and-pepper noise (with probabilities $P_a = P_b = 0.25$). Let $f(x,y)$ denote the filtered result of $I(x,y)$.

Note: You have to define every notation you use in your answer.

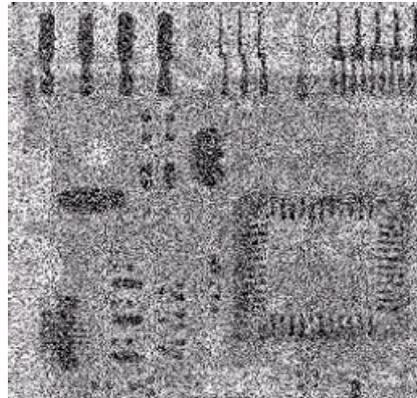


Figure 4.1

- (a) Write down the algorithm of processing $I(x,y)$ with an adaptive median filter. Explain how it works. You are asked to give all the details and situations you can think of.
- (b) One of the following two images is processed by a 7×7 median filter, and the other by an adaptive median filter. Can you tell which is which? Give your reasons for your choice as detailed as possible.

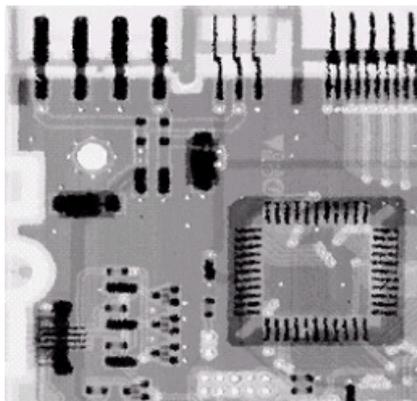


Fig 4.2

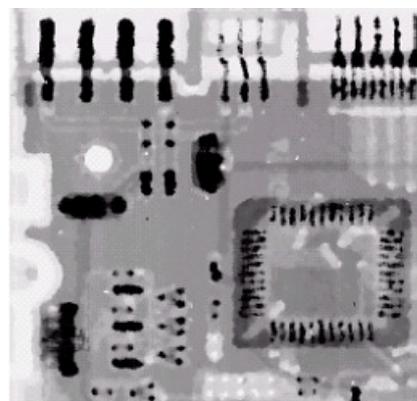


Fig 4.3

5. (20%)

- (a) What are the pros and cons of local histogram equalization comparing to global histogram equalization?
- (b) What are the pros and cons of overlapped local histogram equalization comparing to non-overlapped?

6. (10%)

Consider the following 500×500 RGB color image, shown in Fig 6.1, where the squares are pure red, green, and blue.

(a) What would the result look like when a blur operation with 49×49 averaging mask is applied to the G component image?

(b) Suppose that we convert this image to HSI, blur the H component image with a 49×49 averaging mask, and convert back to RGB. What would the result look like?

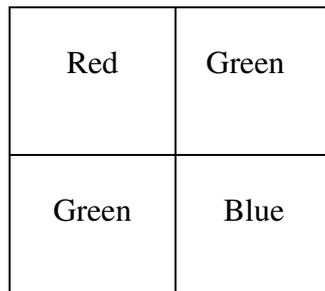


Fig. 6.1