

博士班基本學科考試：數位影像處理

Mar. 11, 2010

1. (30%)
 - (a) (10%) What is the effect of setting the lower-order bit planes to zero on the histogram of an image in general? What would be the effect on the histogram if we set zero to the higher-order bit planes instead?
 - (b) (5%) Suppose that a digital image is subjected to histogram equalization. Show that a second pass of histogram equalization will produce exactly the same result as the first pass.
 - (c) (5%) Discuss the advantages and disadvantages of local and global histogram equalization.
 - (d) (10%) The following two images are both of size 80 by 80.

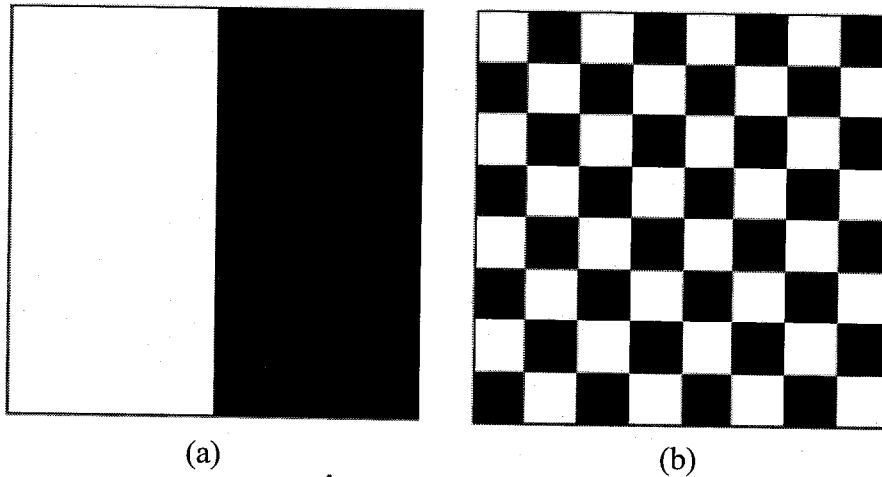


Fig. 1

Please plot their histograms. Suppose that both images are filtered by a 3 by 3 smoothing mask. Please draw the histograms of the resultant images.

Note: the black lines are just used to show the boundaries of the two images but not part of them.

2. (10%) In noise removal, a low pass filter with all coefficients set to 1 is adopted (i.e. box-filter or moving average algorithm). We can update only part of the computation that changes from one pixel location to the next. Formulate such an algorithm for an n by n filter, showing the nature of the computation involved and the scanning sequence used for moving the mask around the image.
3. (15%) Figure 2 shows several vertical bars with 5 pixels wide and 100 pixels high and their separation is 20 pixels. What would this image look like after applying

- (a) A 23 by 23 mean filter?
- (b) A 25 by 25 mean filter?
- (c) A 45 by 45 mean filter?

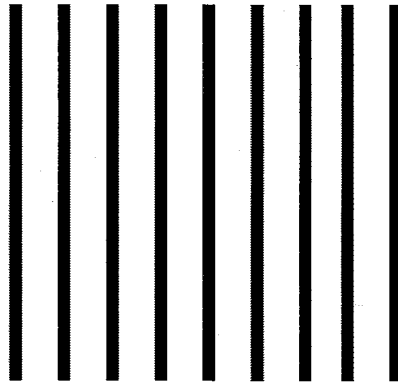


Fig. 2

4. (15%) For this problem, try to count how many butterflies are there in the image with the help of morphological processing techniques. State your method clearly.

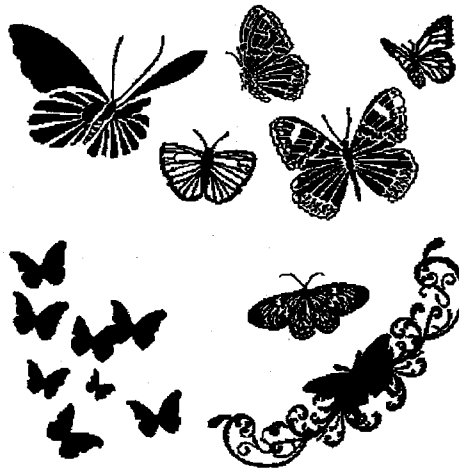


Fig. 3 A binary image

5. (30%)
- (a) (10%) Reflection can be seen as a special scaling operation with scaling constant S_x and S_y taking 1 or -1. Now consider a line passing two points $A=(1,1)$ and $B=(3,3)$ as the axis of reflection. Show that a reflection about this line is equivalent to a reflection with respect to x-axis followed by a 90-degree rotation.
 - (b) (15%) Develop a morphing method to convert a square image (a) to a perfect elliptical image (b). Please state your idea as much as possible (you may assume sizes of images (a) and (b) are given).
 - (c) (5%) If you use polynomial warping with 9 control points, is it possible to get the perfect elliptical contour in image (b)? Justify your answer.