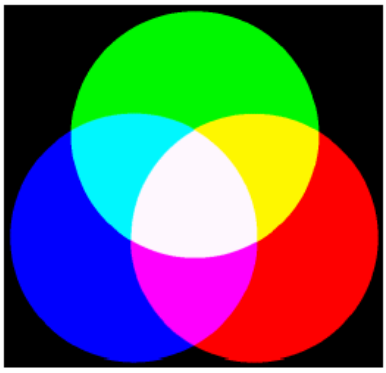
資訊網路與多媒體研究所

資格考試科目：數位影像處理

2008 年 3 月 13 日



1. (20%)

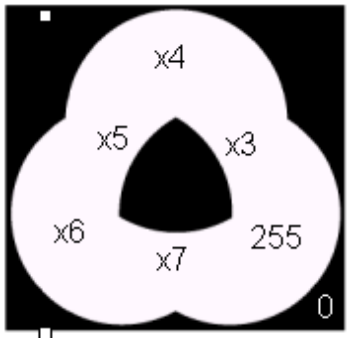
The following three 8-bit images are (left to right) the *H, S,* and *I* component images extracted from the above image. The numbers indicate gray-level values. Answer the following questions, explaining the basis for your answer in each. If it is not possible to answer a question based on the given information, state why you cannot do so.

(a) Give the gray-level values of x1 and x2 in the hue image.

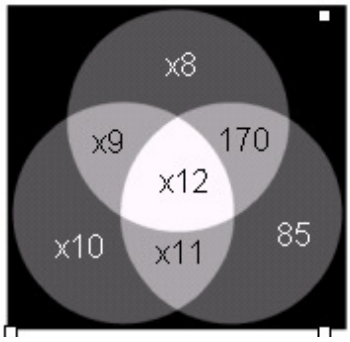
(b) Give the gray-level values of x3, …, x7 in the saturation image.

(c) Give the gray-level values of x8, …, x12 in the intensity image.

the hue image



the saturation image



the intensity image

2. (20%)

(a) What is histogram equalization? Write down the algorithm and pseudo codes for histogram equalization. Explain why histogram equalization can be used for image enhancement.

(b) Is the histogram equalization operation idempotent? Why?

3. (20%)

The general form of a bilinear function $g(.)$ of two variables is:

$$g(\alpha,\beta) = A_0 + A_1\alpha + A_2\beta + A_3\alpha\beta \tag{2.1}$$

Consider Figure 2.1. The problem of image interpolation is to compute $g(x,y)$ given its four neighbors, f_0, f_1, f_2, and f_3. Using the bilinear function given in equation (2.1), derive the following interpolation function:

$$g(\alpha,\beta) = (1-\alpha)(1-\beta)f_0 + \alpha(1-\beta)f_1 + (1-\alpha)\,\beta\, f_2 + \alpha\beta\, f_3 \tag{2.2}$$

where $0 \le \alpha \le 1$ and $0 \le \beta \le 1$.

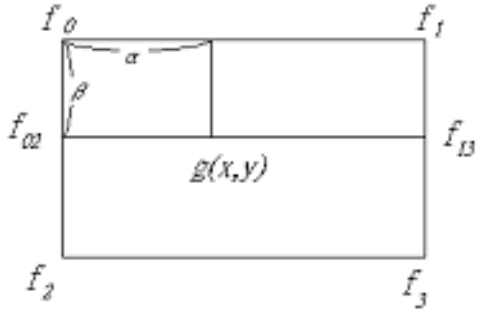


Figure 2.1

4. (20%)

A gray-scale image, $f(x,y)$, is corrupted by additive noise spikes that can be modeled as small, cylindrical artifacts of radii $R_{\min} \leqq r \leqq R_{\max}$ and amplitude $A_{\min} \leqq a \leqq A_{\max}$. Develop a morphological filtering approach for cleaning up the image. Please describe the limitation of your approach. (For example, when does it not work?)

5. (20%)

(a) What is the Wiener filter? Is it optimal? If yes, in which sense?

(b) When does the Wiener filter reduce to the inverse filter? Why?