00873

M.Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)
M.Sc. (MACS)

Term-End Examination

June, 2012

MMTE-003 : PATTERN RECOGNITION AND IMAGE PROCESSING

Time : 2 hours *Maximum Marks : 50*

Note : *Attempt **any five** questions. Each question carries **equal** marks.*

1. (a) Explain why discrete histogram equalization does not in general yield a flat histogram ? 3

(b) Show that a second pass of histogram equalization will produce exactly the same result as the first pass. 3

(c) Propose a gray level slicing algorithm capable of producing the 2-nd bit plane of an 8-bit monochrome image. 4

2. (a) Given that : 5

$$g(x, y) = \frac{1}{MN} \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} \{f(m, n)h(x + m, y + n)\}$$

where f and g are real images and h is a spatial filter :
obtain G(u, v), in terms of F(u, v), and H(u, v), the 2-D Fourier transform of g(x, y).

(b) Describe homomorphic filtering. Explain why the filtering scheme is effective for the applications it is used. 5

3. (a) Explain in detail the adaptive mean and median filters. 4

(b) Obtain mean and variance of the following noise pdfs : 6

(i) $$p(Z) = \begin{cases} ae^{-az} & ; Z \geq 0 \\ 0 & ; Z < 0 \end{cases}$$

(ii) $$p(Z) = \begin{cases} \frac{1}{b - a} & ; a \leq Z \leq b \\ 0 & ; \textit{otherwise} \end{cases}$$

(iii) $$p(Z) = \begin{cases} P_a & ; Z = a \\ P_b & ; Z = b \\ 0 & ; \textit{otherwise} \end{cases}$$

4. (a) Using 0, 1 or -1 as coefficient values give the form for eight operators that measure gradients of edges oriented in eight directions : E, NE, N, NW, W, SW, S and SE. Specify the gradient direction of each mask. 6

(b) Explain the Graph Theoretic technique for edge detection and linking. 4

5. (a) Explain in detail Otsu's method for global thresholding. 5

(b) A bullet is 2.5 cm long, 1 cm wide and its range of speed is 750 ± 250 m/s. The bullet in flight is captured by a camera that exposes the scene for K sec and the bullet occupies 10% of the horizontal resolution of 256×256 frames. 5

Propose methods for :

(i) Automatic segmentation of the bullet.

(ii) Automatic determination of speed of the bullet.

6. (a) Explain the Lempal - Ziv - Welch coding algorithm. What types of redundancies does it remove ? 5

(b) Apply the perceptron algorithm to the following pattern classes : 5

$W_1 = \{(0,0,0)^T, (1,0,0)^T, (1,0,1)^T, (1,1,0)^T\}$.

$W_2 = \{(0,0,1)^T, (0,1,1)^T, (0,1,0)^T, (1,1,1)^T\}$.

Let $C = 1$ and $W(1) = (-1, -2, -2, 0)^T$.

Sketch the decision surface.