00178

M.A.C.S.

Term-End Examination

June, 2010

MMTE-003 : PATTERN RECOGNITION AND IMAGE PROCESSING

Time : 2 hours *Maximum Marks : 50*

Note : *Attempt **any five** questions. All questions carry **equal** marks. Use of calculator is not allowed.*

1. (a) Given an image with following histogram (0, 4, 8, 12, 12, 8, 4, 0), apply equalization to it. What is the resulting histogram ? **5**

(b) Obtain the histogram that results from applying histogram specification to the original image, given that the desired histogram is (12, 8, 4, 0, 0, 4, 8, 12). **5**

2. (a) Obtain the Radon transform of $f(x,y) = A \exp(-x^2 - y^2)$. **5**

(b) Given that the Radon transform of $f(x,y) = g(P, \Theta)$ obtain the Radon transform of $f(x - x_0, y - y_0)$ **3**

(c) Show that Radon transform is a linear transform. **2**

3. (a) Compute the Golomb Code $G_3(n)$ for $0 \leq n \leq 15$. **5**

(b) Derive the Lloyd-Max decision and reconstruction levels for $L=4$ and the uniform probability density function : 5

$$P(s)=\begin{cases}\frac{1}{2A} ; -A \leq S \leq A. \\ 0 ; \text{otherwise}\end{cases}$$

4. (a) Let $u=[u_1, u_2, 1]^T$ and $v=[v_1, v_2, 1]^T$ denote homogeneous coordinates of points in planes P and Q respectively. Matching pairs are related by a projection matrix : 8

$v_i = H\, u_i,\ i=1, 2, \ldots, n$

A transform from P to Q in the form of translation by (x_0, x_1) then a rotation by Θ, then a scaling by (s_0, s_1) is described by the matrix

$$H=\begin{bmatrix} 0.951623 & 0.443749 & -6.97686 \\ -0.401487 & 0.860992 & -2.29753 \\ 0 & 0 & 1 \end{bmatrix}$$

Determine the values of $(x_0, x_1, s_0, s_1, \Theta)$.

(b) Explain the difference between forward and reverse map in Affine transform. 2

5. (a) Given salt and pepper noise with following pdf.

$$P(Z)=\begin{cases} p_a & ; \ Z=-255 \\ p_b & ; \ Z=255 \\ 1-(p_a+p_b) & ; \ Z=0 \end{cases}$$

(i) Obtain the mean and variance of this distribution. 4

(ii). Obtain the mean and variance for exponential distribution given as : 3

$$P(Z) = \begin{cases} a\, e^{-az} & ; \quad Z \geq 0 \\ 0 & ; \quad Z < 0 \end{cases}$$

with $a > 0$.

(b) Briefly explain the methods for estimating the degradation function. 3

6. (a) Explain the Canny Edge detector and clearly highlight its strength. 5

(b) (i) Explain the Global thresholding using Otsu's method. 3

(ii) Clearly state the steps involved in Otsu's method. 2

7. (a) The following pattern classes have Gaussian pdf. 5

$W_1 : \{(0, 0)^T, (2, 0)^T, (2, 2)^T, (0, 2)^T\}$ &

$W_2 = \{(4, 4)^T, (6, 4)^T, (6, 6)^T, (4, 6)^T\}$

Assume $P(W_1) = P(W_2) = \frac{1}{2}$ obtain the equation of the Bayes decision boundary between the classes.

(b) Consider an image given in matrix form as follows : 5

$$h(m, \quad n) = \delta(m, \quad n) + \frac{1}{4}\{\delta(m-1, \quad n) + \delta(m+1, n) + \delta(m, n-1) + \delta(m, n+1)\}$$

Assume image to be 0, outside the window. Find the effect of applying the mask i.e. by filtering through the above system.