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00243

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

Term-End Examination

June, 2011

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 the following histogram (0, 10, 0, 10, 0, 10, 0, 10). Apply equalization and obtain the resulting histogram. **5**

(b) List and briefly explain any five intensity transformation functions commonly used in image processing. **5**

2. (a) Show that rotating an image $f(x, y)$ by an angle θ_0 results in the rotation of the 2-D Fourier Transform F (u, v) by the same angle. **3**

(b) Given that the 2-D Fourier transform F (u, v) is real and odd, obtain the constraints on the form of image $f(x, y)$ **3**

(c) Define homomorphic filtering. Where is such filtering used and why ? 4

3. (a) Explain the functioning of the following adaptive filters. 4
   (i) Adaptive mean filter
   (ii) Adaptive median filter

   (b) Describe Optimal Notch filtering. Derive the mathematical expression to explain its functioning. 4

   (c) Given that blurring degradation can be modeled as convolution with the function 2

$$h(x, y) = \frac{x^2+y^2-2\sigma^2}{\sigma^4} \cdot e^{-\frac{x^2+y^2}{2\sigma^2}}$$

   Obtain the degradation in the frequency domain.

4. (a) Explain how the Fourier slice theorem can be used for reconstructing the original image from the projections. 4

   (b) Suggest a strategy for making the reconstruction computationally efficient. 2

   (c) Obtain the Radon Transform of the following function. 4

$$f(x, y) = \begin{cases} A \; ; & |x|, |y| \leq r \\ 0 \; ; & \text{otherwise} \end{cases}$$

5. Given an image with uniform histogram. Explain the effect of applying following compression techniques : (i) Huffman, (ii) Golomb (iii) LZW, (iv) Prediction coding and (v) Optimal Quantization. **10**

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

   (b) Explain in detail how Hough Transform can be used for edge linking. Bring out the details of the Hough transform in the explanation. **5**

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

   $W_1 = \{(0, 0)^T, (2, 0)^T, (2, 2)^T, (0, 2)^T\}$ and

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

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

   (b) List and briefly explain any five statistical descriptors for textures. **5**