53 (EC-714) DIPR

2015

DIGITAL IMAGE PROCESSING

Paper : EC 714

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* A band limited continuous image is sampled with sampling frequency 'ω_x' and 'ω_y'. Write down the mathematical expression of the sampled image. Draw the frequency domain representation of the image and hence explain the effect of aliasing. How the continuous image can be reconstructed from the sampled image ? 12

   (b) State the practical limitations of sampling. 8

2. *(a)* Write the mathematical expression of two dimensional convolution. An (MI×NI) image is convolved with (M2×N2) image. What would be the dimension of the convolved image? Perform one dimensional convolution for the following functions 2+2+6

$$x_1(n)=\left[\underset{\uparrow}{1}\,2\,3\,4\right] \qquad x_2(n)=\left[2\,\underset{\uparrow}{3}\,1\,4\right]$$

(b) Compare the order of complexity for DFT and FFT. Perform FFT operation for the given sequence 3+7

$$x(n)=[3\,4\,6\,8]$$

3. *(a)* What is the speciality of DCT compare to Fourier Transform? Write down the Forward and Inverse equation of DCT for two-dimensional images. Show with example how to build the transformation matrix for performing one dimensional DFT of 4-point sample sequence. 3+3+4

(b) Describe the advantage of Hadamard Transform compared to other orthogonal transformations. Describe how to get a 8-order Hadamard matrix from a two-order Hadamard matrix. The two matrices A and B are given below.

Find out their Krowcker product $(A \Theta B)$. 3+3+4

$$A = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix} \text{ and } B = \begin{bmatrix} -1 & 2 \\ 2 & 1 \end{bmatrix}.$$

4. *(a)* One image pixel with coordiante (1, 2) is passed through several orthogonal transformations. First it is shifted by (2) unit along x-axis and (–1) unit along y-axis. Later on it is scaled by 2 times along both y and x direction. Finally it is rotated at an angle of 60° with reference to (0, 0) point. Find out the final point. 7

(b) Discuss how the mask of spatial domain filters are designed. Using that designed mask, find out the Laplacian values of the following image in the circled locations. 3+4+6

23	35	45	33	45	45
23	87	65	98	67	45
34	67	32	34	54	45
32	87	30	32	76	45
32	92	87	87	65	45
45	54	54	54	54	65

5. Discuss the methods of estimating degradation models of image. What is the difference between blurred image and noisy image ? Can you mathematically model the blurring effect which is caused by the movement of the camera during image acquisition ? Discuss what would be the reconstruction transfer function for that blurred image ? What are the advantages of winner filter over 1st and 2nd order lowpass filter ? 7+2+6+3+2

6. *(a)* Discuss the steps of JPEG image coding and decoding.

(b) Name one hardware or device where run-length coding can be effectively implemented and justify the reason.

(c) A source emits binary symbol and it is encoded by run-length coding. Assume that the maximum run length is M $(m = log_2 M)$. Let the source emit '0' with probability 'p' and 'I' with probability 'I-p'. If the compression factor is calculated over 'N' nos. of emitted symbols, show that the compression factor $C = \frac{N}{m} = \frac{(1 - pM)}{m(1 - p)}$. 10+3+7

7. Write short notes on : ***(any two)*** 10×2

(a) KL Transform.

(b) Homo-morphic filtering.

(c) Constrained least square filtering.

(d) Histogram specification.
