53 (EC 714) DIPR

2018

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)* State the sampling theorem for 2D signal. Let $f(x, y)$ is a continuous 2D signal which is sampled by a series of impulse function grid. The distance between two impulse function along x direction is Δ_x and along y direction is Δ_y. Find out the expression of the sampled signal both in spatial and frequency domain. 8

(b) Draw the spectrum of the signal before and after sampling. Assume the signal is band limited with W_u *Hz* along u direction and W_u *Hz* along v direction. 10

(c) Explain aliasing effect from the drawn figure in part *(b)*. 2

2. (a) What is meant by uniform and non-uniform quantization? Find the expression of decision level and reconstruction level in case of Max Llyod quantizer. 4+8

(b) A point (2, 3) is translated by (4 ; 6) and then rotated by +45°. Find the final point. 8

3. (a) Construct the filter mask of a differentiator to map the following equations. 4×2

(a) $f'(x, y) = (f(x+1, y) - f(x, y)) + (f(x, y+1) - f(x, y))$

(b) $f''(x, y) = f(x+1, y) + f(x-1, y) - 2f(x, y)$

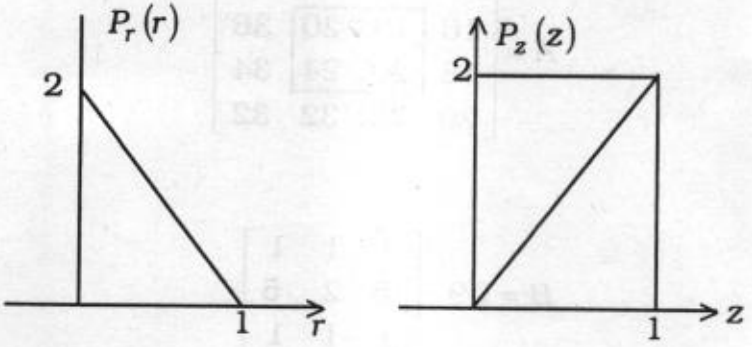
(b) An image A is filtered with a mask B. Find out the filtered image. The image A and mask B are given below. You can ignore the border points. 12

$$A = \begin{bmatrix} 12 & 16 & 18 & 38 \\ 16 & 18 & 20 & 36 \\ 18 & 20 & 24 & 34 \\ 20 & 28 & 32 & 32 \end{bmatrix}$$

$$B = 1/9 \begin{bmatrix} 1 & 1 & 1 \\ \cdot 5 & 2 & \cdot 5 \\ 1 & 1 & 1 \end{bmatrix}$$

4. (a) State the difference between histogram equalization and histogram specification. 6

(b) An image with intensities in the range [0, 1] has the PDF, $P_r(r)$ as shown in the left side of the following figure. It is desired to transform the intensity levels of the image so that they will have a specified $P_z(z)$ as shown in the right side of the following figure. Assume continuous quantities and find the transformation (in terms of r and z) that will accomplish this. 10



(c) Compare Beizer curve and quadratic spline curve. 4

5. (a) Explain importance of the separability properly of a transformation kernel. 4

(b) Write down the forward and inverse transformation expression of the following transformations. 9

(a) DFT (b) DCT (c) DHT

(c) Describe the steps of forward K-L transform. 7

6. (a) Why do we need image compression? What are practical limitations of transmission of video data over transmission line without any suitable compression method. 3+3

(b) What is run-length coding? Derive the expression of compression factor of a run-length coding

$$C = \mu \Big/ m = \frac{1 - P^M}{m(1 - P)}$$

where, M is the maximum run-length, P is the probability that an event to be 0, m is no. of bits it takes to represent each run and μ is the length of sequence of binary symbols.

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7. Write short notes on : ***(any two)*** 20

(i) Winner filtering

(ii) FFT

(iii) Homomorphic filtering

(iv) JPEG

(v) Predictive coding.
