Exam Date & Time: 27-Jul-2022 (09:00 AM - 12:00 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

FIRST SEMESTER B.TECH MAKE-UP EXAMINATIONS, JULY 2022 DIGITAL IMAGE PROCESSING [BME 3252]

Marks: 50

Duration: 180 mins.

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) Consider the system with input-output relationship: $y(m,n) = x^2(m, n)$. Find out if the system is linear, shift-invariant, and causal. Justify each of your answers mathematically. (4)

A)

- B) It is often sufficient to know the working of a 1D system, to understand that of its counterpart on an image. Accordingly, consider the system with input-output relationship: y(n) = (1/3) [-x(n-1) + 2x(n) - x(n+1)].Find the expression for the frequency-response of the filter, and plot its magnitude. (3)
- C) Consider filtering a 2D sequence of size 610×760 . The size of the filtering kernel is 50×50 . Find the number of zeros to be padded to the two sequences, to allow linear filtering by the kernel, using an FFT algorithm (3)
- Explain the experiment to assess the *just-noticeable difference* associated with a subject.
 What is the conclusion of the experiment? What would be the results, if you allow infinitesimal (continual) increments in intensity explain mathematically. (5)

A)

B) Compute the 3 X 3 Discrete Cosine Transform (DCT) matrix, withe numerical entries, given the following expression for the DCT:

$$C_{x}(k) = v(k) \sum_{n=0}^{N-1} x(n) \cos\left[\frac{\pi}{2N} (2n+1)k\right], \quad 0 \le k \le N-1$$
where: $v(0) = \sqrt{\frac{1}{N}}, \quad v(k) = \sqrt{\frac{2}{N}}, \quad 1 \le k \le N-1$
(5)

Compute the inverse of the DCT matrix with numerical values.

3) Compute the output of the 5-point averaging filter i.e., the filter whose mask is given by:

A)
$$\begin{array}{c} 0.0 & 0.2 & 0.0 \\ 0.2 & 0.2 & 0.2 \end{array}$$
(4)

0.0 0.2 0.0

on the following image (Fig. 1). Show the calculations any three important locations.

8	8	8	8	20	20	10	20	20
8	8	8	8	20	20	10	20	20
8	8	28	8	20	20	10	20	20
8	8	8	8	20	20	10	20	20
20	20	20	20	20	20	10	20	20
20	20	20	20	20	20	10	20	20
20	20	20	20	20	20	10	20	20
20	20	20	20	20	20	10	20	20

Figure 1.

B) Find the output of a 5-point median filter i.e., a median filter with a cross-shaped support as shown in the following:

	x	
X	X	x
	x	

on the image in Fig. 1 (previous question). Show the calculations at any 3 important locations.

	C)	Compare the results averaging and median filtering, by pointing out the important regions in the two output images.	(2)
4)		Develop from fundamentals, the gradient-based edge-detection scheme.	(5)
	A)		
	B)	Write the complete <i>pseudo-code</i> to detect the presence of parabolae of the form: $ax^2 + bx + c = 0$ in digital images.	(5)
5)		Find the result of closing a circular disc by itself. You must sketch all the intermediate results, clearly.	(4)
	A)		
	B)	Explain the application of morphological operations for finger-print enhancement.	(4)
	C)	What are the desirable properties of feature-vectors for successful classification?	(2)

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