



Digital Image Processing
Spring Semester Exam.



Mansoura University
Faculty of Engineering

Biomedical Engineering Program - Level 300

Exam Date: 27-12-2018

Allowed Time: 2 Hours

Attempt all questions. Assume any missed data. Full mark is 50

Q.1.a) Correct the errors, if any, in each of the following statements:

[5 Marks]

إذا كانت الجملة صحيحة يكتب رقم الجملة وعلامة (✓) فقط أمامها، أما إذا كانت الجملة خطأ فتوضع علامة (x) أمام رقم الجملة، وتعاد كتابة الجملة كاملة بعد تصحيحها.

- In transform processing, a pixel's grey value is changed without any knowledge of its surrounds.
- Speckle noise can be cleaned by using median filter.
- In a step edge, the grey values change slowly.
- Hue is the amount by which the color has been diluted with white.
- Color processing must be done using YIQ color model.

Q.1.b) Complete the following statements:

[5 Marks]

- is the density of pixels over the image.
- The of a grey-scale image is its photographic negative.
- is an example of additive noise.
- refers to the operation of partitioning an image into separate objects.
- a local discontinuity in the pixel values which exceeds a given threshold.
- The human visual system is particularly attuned to two things; and

Q.2) Give a short answer to each of the following questions:

[15 Marks]

- "Image processing operations may be divided into three classes based on the information required to perform the transformation". Justify this statement. Give a block diagram realization for one of the three classes.
 - "Suppose we wish to convolve an image M with a spatial filter S ". Write the main steps proposed by the convolution theorem to get the result.
 - "The idea of unsharp masking is to subtract a scaled unsharp version of the image from the original". Sketch a block diagram to implement this process.
 - The Fourier transform is of fundamental importance to image processing". Justify this statement. Write down the equations of the 2D discrete Fourier transform.
 - "A color model is a method for specifying colors in some standard way". Discuss the main three color models that are commonly used.
-

Q.3.a) Use *MATLAB* to read the image "real.jpg". Transform it into grey-scale. Add 10% salt and pepper noise to the image. Attempt to remove noise using median filtering (Size 3x3). Obtain the edges of the original color image using *RGB* color model. **[5 Marks]**



Q.3.b) Given a 5x5 image, X , and an average filter, H

$$X = \begin{bmatrix} 150 & 130 & 073 & 045 & 050 \\ 140 & 155 & 070 & 050 & 048 \\ 180 & 160 & 070 & 050 & 052 \\ 170 & 175 & 075 & 045 & 047 \\ 200 & 160 & 070 & 045 & 047 \end{bmatrix}, \quad H = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

Apply the given edge detector to the image. Apply a suitable threshold to transform the resulting image into a binary one. **[5 Marks]**

Q.4.a) Derive the parametric form of a straight line in an image. Use the Hough transform to detect the two strongest lines in the binary image shown below. **[10 Marks]**

		X						
		0	1	2	3	4	5	6
0		1	0	0	0	0	1	1
1		0	0	0	0	0	1	0
2		0	1	0	0	0	0	0
3	y	1	0	1	0	0	1	1
4		0	0	0	0	0	0	0
5		0	0	0	0	0	1	0
6		0	0	0	0	0	0	0

Q.4.b) Suppose a 4-bit grey-scale image has the following grey values distribution:

i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
n_i	20	40	90	55	90	30	25	5	0	0	0	0	0	0	0	5

- Sketch the histogram of this image. What do you expect about the appearance of this image?
- Use histogram stretching to improve the appearance of the image. Sketch the result.

Hint: Use the following stretching function: $j = \frac{14-2}{7-1}(i-1) + 2, \quad 1 \leq i \leq 7$

- Repeat the solution using histogram equalization. Sketch the result.

[10 Marks]

☺ *Best wishes* ☺

Assoc. Prof. Hossam El-Din Moustafa