
 Mansoura University	 Faculty of Engineering	Biomedical Engineering (BME) Department
		Time allowed: 1 Hour
		Exam is three pages, Full mark=30
		Assume any missing data; solve in same paper
:الفصل		الاسم:

Question # 1: [30 points, each is 5 points] Answer the following, showing details if possible

1.1 Draw a block diagram of x-ray device

1.2 Find distance shape map of the following image, O1, where one indicates the object

Object training Image, O1

0	0	0	0	0
0	0	1	0	0
0	1	1	1	0
0	1	1	1	0
0	0	1	0	0



Distance map shape model

1.3 If x-ray projections of 2x2 image pixels are as follows: horizontal=[3 8], vertical=[6 5], main diagonal=[4], and reverse main diagonal =[7]. Reconstruct the image using ART algorithm

1.4 Compute the M-step, for the following 3x3 E-step responsibilities for the given image Y:

Image; Y

7	5	4
3	2	1
4	1	0
5	5	6

$\pi(x = 0|Y)$

1	1	0.9
1	0.1	0.2
1	0.3	0
0.5	1	1

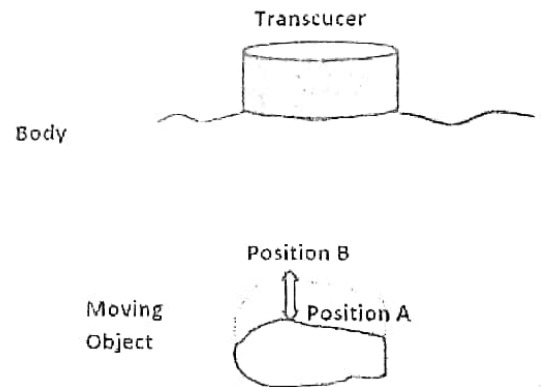
$\pi(x = 1|Y)$



0	0	0.1
0	0.9	0.8
0	0.7	1
0.5	0	0

1.5 A training image Y with three grey levels $\{0,1,2\}$ and its labeled image X has two labels "1 is object" and "0 is background". If $p(X) = [0.2 \ 0.8]$; $p(Y|X = 0) = [0.2 \ 0.3 \ 0.5]$, and $p(Y|X = 1) = [0.5 \ 0.3 \ 0.2]$, classify the following 3×3 test image, Y_1 , using the Bayes rule classifier

Test Y_1		
0	1	2
0	1	2
0	1	2

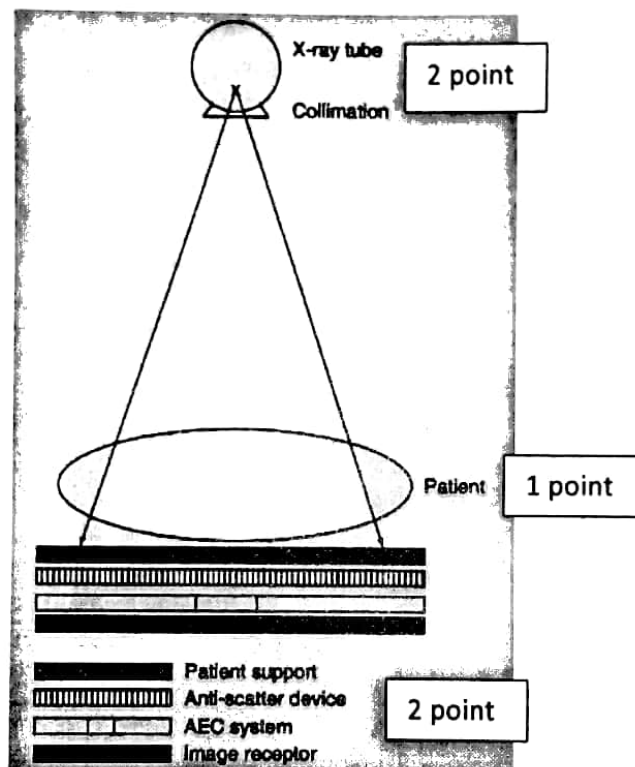
1.6 How m-mode ultrasonic is performed. How it looks for the following periodically moving structure?



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Question # 1: [30 points, each is 5 points] Answer the following, showing details if possible

1.1 Draw a block diagram of x-ray device



1.2 Find distance shape map of the following image, O1, where one indicates the object

$$\phi(i,j) = \begin{cases} 0 & \text{On The Boundary} \\ -d([ij], O_{Edges}) & \text{Inside the Object} \\ d([ij], O_{Edges}) & \text{Outside the Object} \end{cases}$$

1 point

1 point

3 point

Object training Image, O1

0	0	0	0	0
0	0	1	0	0
0	1	1	1	0
0	1	1	1	0
0	0	1	0	0

Distance map shape model

$\sqrt{5}$	$\sqrt{2}$	1	$\sqrt{2}$	$\sqrt{5}$
$\sqrt{2}$	1	0	1	$\sqrt{2}$
1	0	-1	0	1
1	0	-1	0	1
$\sqrt{2}$	1	0	1	$\sqrt{2}$

Points are on getting the corresponding correct numbers on the distance map model

1.3 If x-ray projections of 2x2 image pixels are as follows: horizontal=[3 8], vertical=[6 5], main diagonal=[4], and reverse main diagonal=[7]. Reconstruct the image using ART algorithm

(1) Vertical					(2) Horizontal					(3) Diagonal													
Initial	MyV	E	Updated		MyH	E	Updated		MyD	E			Final										
<table><tr><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td></tr></table>	0	0	0	0	0	6	<table><tr><td>3</td><td>2.5</td></tr></table>	3	2.5		5.5	-2.5	<table><tr><td>1.75</td><td>1.25</td></tr></table>	1.75	1.25		5.5	1.5			<table><tr><td>1</td><td>2</td></tr></table>	1	2
0	0																						
0	0																						
3	2.5																						
1.75	1.25																						
1	2																						
<table><tr><td>0</td><td>0</td></tr></table>	0	0	0	5	<table><tr><td>3</td><td>2.5</td></tr></table>	3	2.5		5.5	2.5	<table><tr><td>4.25</td><td>3.75</td></tr></table>	4.25	3.75		5.5	-1.5			<table><tr><td>5</td><td>3</td></tr></table>	5	3		
0	0																						
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					</																		

1.5 A training image Y with three grey levels $\{0,1,2\}$ and its labeled image X has two labels "1 is object" and "0 is background". If $p(X) = [0.2 \ 0.8]$; $p(Y|X=0) = [0.2 \ 0.3 \ 0.5]$, and $p(Y|X=1) = [0.5 \ 0.3 \ 0.2]$, classify the following 3×3 test image, Y_1 , using the Bayes rule classifier

Test Y_1		
0	1	2
0	1	2
0	1	2

$$p(X,Y) = P(Y|X)p(x)$$

Bayes Rule:

2 point

if $p(x=1|Y) \geq p(x=0|Y)$ then decide class $x=1$; otherwise decide class $x=0$

$$p(x|Y) = \frac{P(y|x) p(x)}{p(y)} = \frac{p(X,Y)}{p(y)}$$

Since dividing by $p(y)$ will not change decision, so we can classify based on the joint probability

Joint Probabilities:

2 point

$$p(x=0,Y) = p(Y|x=0)p(x=0) = [0.04 \ 0.06 \ 0.1]$$

$$p(x=1,Y) = p(Y|x=1)p(x=1) = [0.4 \ 0.24 \ 0.16]$$

Since $p(x=1,Y=q) > p(x=0,Y=q)$ for all grey values \rightarrow decision is class $x=1$

Test Y_1 classification

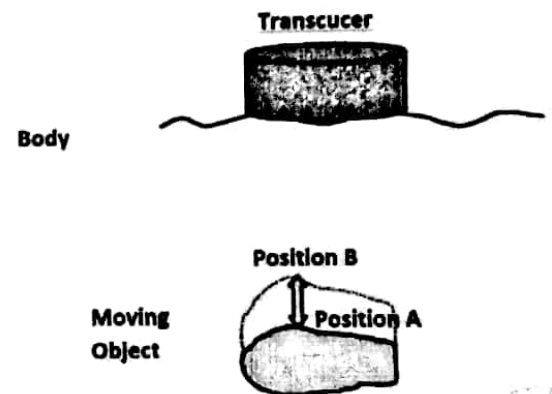
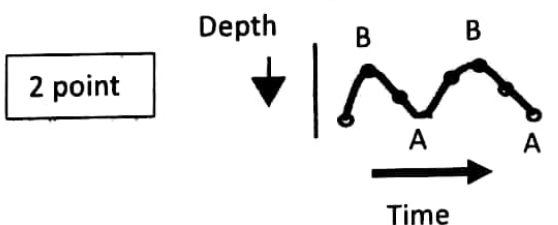
1	1	1
1	1	1
1	1	1

1 point

1.6 How m-mode ultrasonic is performed. How it looks for the following periodically moving structure?

- m-mode ultrasonic is performed by capturing a continuous series of A-mode scans (sending transmitted pulses repeatedly and their echoes are the m-mode scan)

3 point



د. أحمد النقيب

خالص امنياتي بالتوفيق

تمت الاسئلة