DHARMSINH DESAI UNIVERSITY, NADIAD.

FACULTY OF TECHNOLOGY.

ONLINE SESSIONAL EXAMINATION

B.Tech (CE) sem → 7

SUBJECT → Image Processing

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Date: 6/10/2020
Time: 10:00 to 11:15
Total pages. → 14

Q.1

(a) translation property of 2-D discrete fourier transform.

→ ~~trans~~ equation

$$f(x, y)\, e^{j2\pi(u_0 x/M + v_0 y/N)} \Leftrightarrow F(u-u_0, v-v_0)$$

$$f(x-x_0, y-y_0) \Leftrightarrow F(u, v)\, e^{-j2\pi(x_0 u/M + y_0 v/N)}$$

→ There is a simple relationship like 1d for translating an image.

→ here we rotate around boundaries.

$$F(u, v) = |F(u, v)| \exp(j\phi(u, v))$$

(b) True.

(c) Moire pattern

→ Beat patterns that are generated b/w grating of approximately equal spacing.

→ They are generated from sampling scenes with perfectly or nearly periodic components with comparable spacing to that of samples.

→ It can be removed with anti alliasing.

(d) conditions of image segmentation

(1) segmentation must be complete

$$\bigcup_{i=1}^{n} R_i = R$$

(2) pixels in a region must be connected

~~regions must be connected~~

R_i is a connected for $i = 1$ to n

(3) pixels in one region must share same property

$Q(R_i) = \text{True}$ for $i = 1$ to n

(4) regions should differ in context of $Q(R_i)$

$Q(R_i \cup R_j) = \text{false}$ for any adjecent region

(5) regions must be disjoint

$R_i \cap R_j = \emptyset$ for all $i \neq j$

(e) gradient angle

→ shows direction of gradient.

$$\theta = \tan^{-1}\left[\frac{g_y}{g_x}\right]$$

where $g_x = \frac{\partial f}{\partial x}$ $g_y = \frac{\partial f}{\partial y}$

↓ ↓

x-derivative y-derivative

constant intensity areas

→ x & y both derivatives are zero

(f) image partitioning by variable thresholding.

→ here we divide image into non-overlapping rectangles.

→ these rectangles are chosen small enough to make illumination of each of them is approximately uniform

→ it works good when foreground & background have comparable size.

5

Q.2

(a) 1. $F(u,v) = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y) e^{-j2\pi(ux/M + vy/N)}$

$\therefore F(0,0) = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y)$

$= \frac{MN}{MN} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y)$

$= MN \bar{f}(x,y)$

$\left(\bar{f}(x,y) = \frac{1}{MN} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y) \right)$

↳ average value of f

hence proved $F(0,0) \propto \bar{f}(x,y)$

2.

unsharp masking, high boost filtering & high frequency emphasis filtering.

$g_{mask}(x,y) = f(x,y) - f_{LP}(x,y)$

$f_{LP}(x,y) = \mathfrak{F}^{-1}[H_{LP}(u,v)F(u,v)]$

~~high boost filtering~~

$g(x,y) = f(x,y) + k * g_{mask}(x,y)$

when $k = 1 \rightarrow$ unsharp masking

$k > 1 \rightarrow$ high boost filtering

$$F(g(x,y)) = F(f(x,y)) + F(k * g_{mask}(x,y))$$

~~Eqn.~~

$$g_1(x,y) = \mathcal{F}^{-1}\{[1 + k * H_{HP}(u,v)]F(u,v)\}$$

~~high frequency emphasis filtering.~~

expression in square bracket is high frequency emph. filtering.

(b) objectives of canny's approach.

1. edge points should be localized.

i.e. located edges must be as close as possible to true edges. & Distance b/w located edge point & center of true edge should be minimum

2. low error rate

All edges should be found & should be as close as possible to true edges.

3. Single edge point response

→ only one point for each true edge point should be returned.

→ no. of local maxima around true edge should be minimum.

Algo steps

(1) smooth the input image with gausian filter

as 1st derivative of gausian filter closely near to operator optimizing product of signal to noise ratio & localisation

$$\frac{d}{dx} e^{-x^2/2\sigma^2} = \frac{-x}{\sigma^2} e^{-x^2/2\sigma^2}$$

gausian fn $G(x,y) = e^{-\frac{x^2+y^2}{2\sigma^2}}$

smoothed image

$$f_s(x,y) = G(x,y) * f(x,y)$$

(2) compute gradient magnitude & angle images

$$M(x,y) = \sqrt{g_x^2 + g_y^2}$$

$$\alpha(x,y) = \tan^{-1}\left[\frac{g_y}{g_x}\right]$$

(3) non-maxima suppression to gradient magnitude image

- find direction closest to $\alpha(x,y)$

if $M(x,y)$ < atleast one of 2 neighbours along d_k

then $g_N(x,y) = 0$

otherwise $g_N(x,y) = M(x,y)$

(4) thresholding

→ this algo uses hysteresis thresholding

i.e. 2 thresholds

for which ratio should be

2:1 or 3:1 high to low

Q.3

(4) <u>convolution</u>

$$f(x) = \begin{cases} 1/2 & 0 < x < 2 \\ 0 & \text{otherwise} \end{cases}$$

$$h(y) = \begin{cases} 1/3 & 0 < y < 3 \\ 0 & \text{otherwise} \end{cases}$$

(b) algo for edge linking to find polygonal fit

① let P is sequence of ordered, distinct points of binary image.

specify 2 starting points. A, B

② specify a threshold T & 2 empty stacks OPEN & CLOSED.

③ If P are in closed curve, put A into OPEN, B into both

if P are in open,

A → OPEN

B → closed.

for our case →

closed	open
B	B, A

(4) compute parameters of line passing from last vertex in closed to last vertex in open.

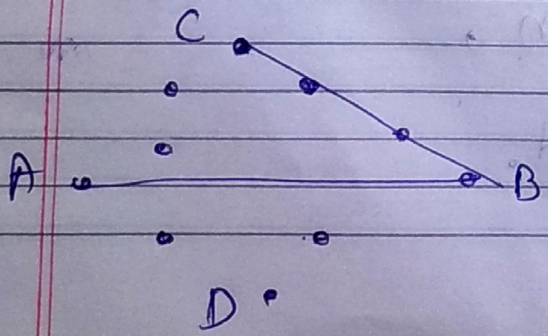
in our case → line BA

(5) compute distances from line in step 4 to all points in P whose sequence places them b/w vertices from step 4.

select point, Vmax, with max distance, Dmax.

(6) If Dmax > T place Vmax at end of OPEN as new vertex goto step (4).

in our case,



CLOSED	OPEN
B	B, A, C

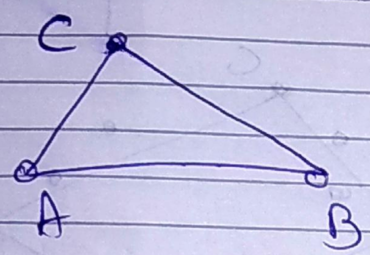
line BC selected

7. else remove last vertex from OPEN & insert it as last in closed.
8. if OPEN not empty, goto step 4
9. else exit vertices in closed are in poly. fit.

in our case,

closed	open
B, C	B, A

CA selected



S, B → Dmax doesnt exceed threshold.

∴

closed	open
B, C, A	B

line A & B selected

next, Dmax > T.

∴

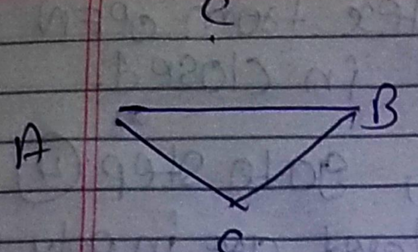
closed	OPEN
B, C, A	B, D

AD selected

open is not empty

closed	open
B, C, A, D	B

BD selected.



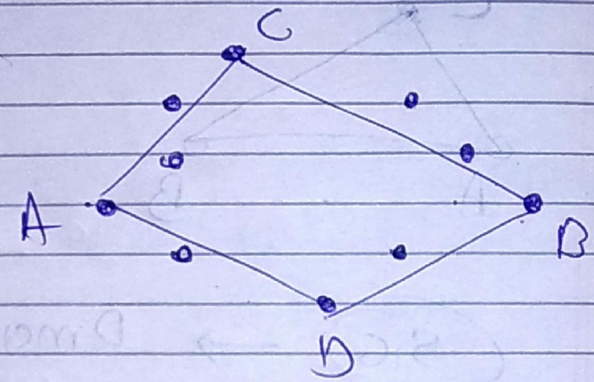
Dmax doesn't exceed threshold

∴

closed	open
B, C, A, D, B	—

now OPEN is empty.

∴ exit



——— end of answersheet ———