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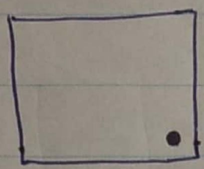
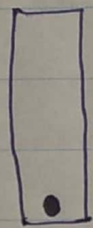
Homework 3

1 (a) Structuring Element:



Operation: Erosion

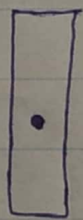
(b) Structuring Element:



Operation: Erosion

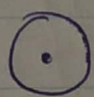
(c) Structuring Element:

Step1:



Operation: opening [Erosion followed by Dilation]

Step2:

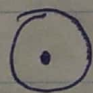


Operation: Erosion.

(d) Step 1: Structing Element

Operation: Dilation

Step 2: Structuring Element



Operation: Closing [Dilation followed by Erosion]

② $P_1(z)$ = represents the probability P_1 of object
$P_2(z)$ = represents the probability P_2 of Background

Using the line equation $y = mx+c$ where m = slope,
and c = y-intercept

Let us assume that $p_1(z)$ and $p_2(z)$ are equal to get optimal threshold

$$P_1(z) = P_2(z)$$

The line passing through the point $(4, 0.5)$ and $(1, 0)$

$$y = \frac{0-0.5}{1-4} x + c$$

$$y = \frac{x}{6} + c$$

Applying the values of $(x, y) = (1, 0)$

$$0 = \frac{1}{6} + c$$

$$c = -1/6$$

$$\therefore y = \frac{x}{6} - \frac{1}{6} \Rightarrow x - 6y = 1 \quad (1)$$

Line passing through (1, 1) and (2, 0)

$$y = \frac{0-1}{2-1} x + c$$

$$y = -x + c$$

Applying $(x, y) = (2, 0)$

$$0 = -2 + c$$

$$c = 2$$

$$\therefore x + y = 2 \text{ ——— } (2)$$

Solving (1) & (2)

$$x + 6y = 1$$

$$\cancel{x} + y = 2$$

$$- \quad - \quad -$$

$$-7y = -1$$

$$y = 1/7$$

$$x = 13/7$$

Therefore $z = 13/7$ is the optimal threshold value b/w object and background pixels assuming that $p_1(z) = p_2(z)$

3) a (i) $y = x - 2$

given this line lets find a perpendicular distance from origin to the given line

$y = (1)x + (-2)$ ——— 1

So here $m = 1$ and $c = -2$, any line $\perp^r$ to this line will have m_2 such that

$$m_1 \cdot m_2 = -1$$
$$(1) \cdot m_2 = -1$$
$$m_2 = -1$$

$y = -x + k$, but $k = 0$ as the line passes through origin.

$\therefore$ $y = -x$ ——— 2

Solve 1 & 2

$$y = x - 2$$
$$y = -x$$
$$\underline{-\qquad +\qquad}$$
$$0 = 2x - 2$$
$$x = 1 \qquad y = -1$$

So $(1, -1)$ is the point where $\perp^r$ meets the line $y = x - 2$

Scanned by CamScanner

$d = \sqrt{x^2+y^2}$ & $\beta = \tan^{-1}(y/x)$

$d = \sqrt{(1)^2+(-1)^2}$ $\beta = \tan^{-1}(-1/1)$

$d = \sqrt{2}$ $\beta = -\pi/4$

The equation of the line in (r, θ) form is

$$r = \frac{d}{\cos(\theta-\beta)}$$

$$r = \frac{\sqrt{2}}{\theta + \pi/4} \quad \text{or} \quad r = \frac{\sqrt{2}}{\theta + 45}$$

(ii) $y = 1 - x/2$

$y = (-1/2)x + 1 \longrightarrow (1)$

$\therefore$ $\perp^r$ line to this will have

$m_2 = 2$

The $\perp^r$ line is given by

$y = 2x \longrightarrow (2)$

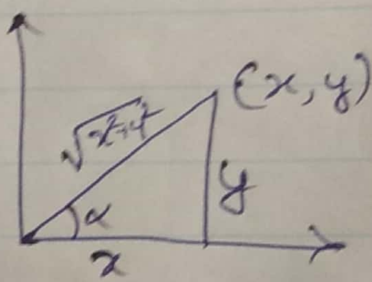
Solving ① & ② $x = 2/5 \quad y = 4/5$

$$d = \sqrt{(2/5)^2 + (4/5)^2} = 2/\sqrt{5}$$

$$\beta = \tan^{-1}(y/x) = \tan^{-1}(2) \approx 63.41^\circ$$

$$\therefore \quad r = \frac{2}{\sqrt{5}\cos(\theta - 63.41^\circ)}$$

(b) $x\cos\theta + y\sin\theta = p$



$$\frac{x}{\sqrt{x^2+y^2}}\cos\theta + \frac{y}{\sqrt{x^2+y^2}} = \frac{p}{\sqrt{x^2+y^2}}$$

$$\cos\alpha\cos\theta + \sin\alpha\sin\theta = p/\sqrt{x^2+y^2}$$

$$\cos(\alpha - \theta) = p/\sqrt{x^2+y^2}$$

$$\sin(90 - (\alpha - \theta)) = p/\sqrt{x^2+y^2}$$

$$\sin(\theta - (\alpha - 90^\circ)) = p/\sqrt{x^2+y^2}$$

$$f = \left(\sqrt{x^2+y^2}\right) \sin\left(\theta - (\alpha - 90^\circ)\right) \quad (1)$$

Compare to standard form of sinosoidal wave

$$y = A\sin(Bx - c)$$

Hence it follows a sinosoidal function.

Thus here

$$\text{Amplitude} = A = \sqrt{x^2+y^2}$$

$$\text{Period} = \frac{2\pi}{B} = 2\pi$$

$$\text{phase angle} = (\alpha - 90)$$

→ As it can be proved, amplitude and point (x, y) are directly related. They are directly propotional

→ Here period of the sinosoidal is a constant $= 2\pi$ and doesnt change with (x, y)

→ Phase angle is directly affected by α i.e the angle suspended by (x, y) at origin $(0,0$