Assignment

7.8 middle part of Canny

perform non-maximum suppression for inner 3×3 array

3	3	3	3	3
3	10	9	5	3
3	20	8	7	3
3	5	30	10	3
3	3	3	3	3

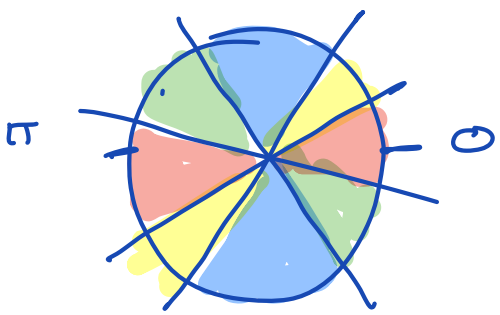
$\|\nabla I\|$

magnitude

0	0	0	0	0
0	0	$-\frac{4\pi}{8}$	0	0
0	$\frac{10\pi}{8}$	$\frac{6\pi}{8}$	0	0
0	$\frac{4\pi}{8}$	0	$\frac{2\pi}{8}$	0
0	0	0	0	0

$\angle(\nabla I)$

phase, θ



Solution

pixel val	angle		neighbors	local max?
10	0	hor. (red)	[3 10 9]	yes
9	$-\frac{4\pi}{8}$	vert (blue)	[3 9 8]	yes

5	$\frac{4\pi}{8}$	vert (blue)	[20 5 3]	no
30	0	hor	[50 30 10]	yes

→

10	9	0
0	8	0
0	30	10

after non-max supression.

7.18 compute Harris Stephens corner measure for central pixel, assume 3×3 window with uniform weight.

$$I_x = \begin{bmatrix} -5 & -9 & 5 \\ 7 & 3 & -8 \\ -6 & 9 & 3 \end{bmatrix} \qquad I_y = \begin{bmatrix} 2 & -7 & -6 \\ -1 & 8 & 9 \\ -5 & 2 & 3 \end{bmatrix}$$

$$M = \sum_{x \in R} w(x) \begin{bmatrix} I_x^2 & I_x I_y \\ I_x I_y & I_y^2 \end{bmatrix} = \begin{bmatrix} \Sigma x & \Sigma xy \\ \Sigma xy & \Sigma y \end{bmatrix}$$

$x \in R$: 3×3 region; w: uniform weight, set to 1

$$R = \det M - k\,[\text{trace}(M)]^2$$

k: typ ~ 0.04 – 0.06

$R < 0$: edge

$|R|$ small : flat

$R > 0$: corner

Solution

$$I_x = 25 + 81 + 25 + 49 + \cdots = 379$$

$$(-5)^2 + (-9)^2 \cdots$$

$$I_y = (2)^2 + (-7)^2 + (-6)^2 + \cdots = 273$$

$$I_x \cdot I_y = (-5)\cdot 2 + (-9)\cdot(-7) + 5\cdot(-6) + \cdots = 25$$

$$M = \begin{bmatrix} 379 & 25 \\ 25 & 273 \end{bmatrix}$$

$$\det M = 379 \cdot 273 - (25)^2 = 102842$$

$$\text{trace } M = 379 + 273 = 652$$

let $k = 0.04$

$$R = \text{cornerness} = \det M - k \cdot \text{trace } M$$

$$= 85838$$

$R > 0$ and not small $\Rightarrow$ possible corner point