Lecture 7 Further Edge Detection

COMP3204 & COMP6223 Computer Vision

What better ways are there to detect edges?

Book pp 153 - 172

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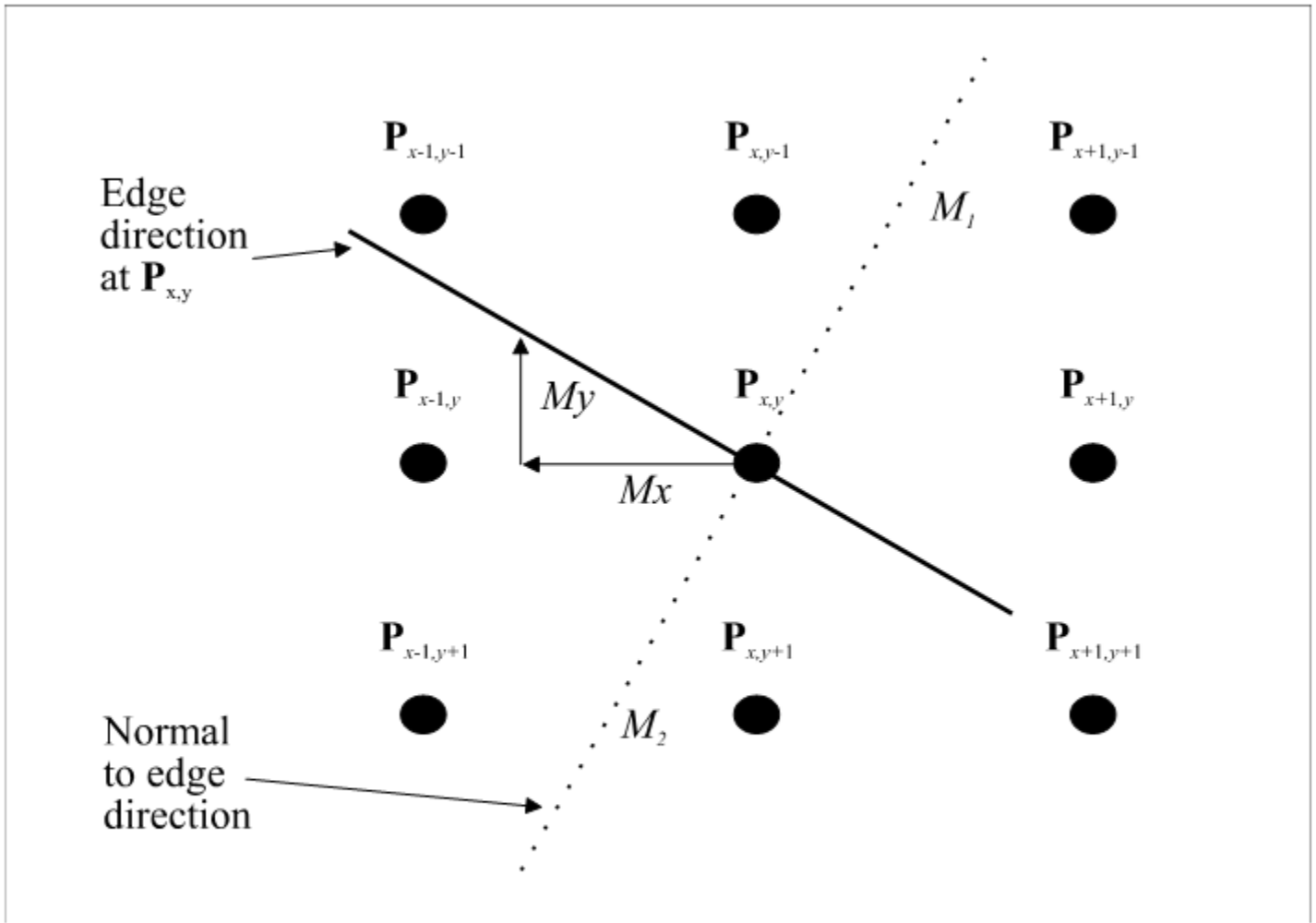
(a) original image

(b) Sobel edge magnitude

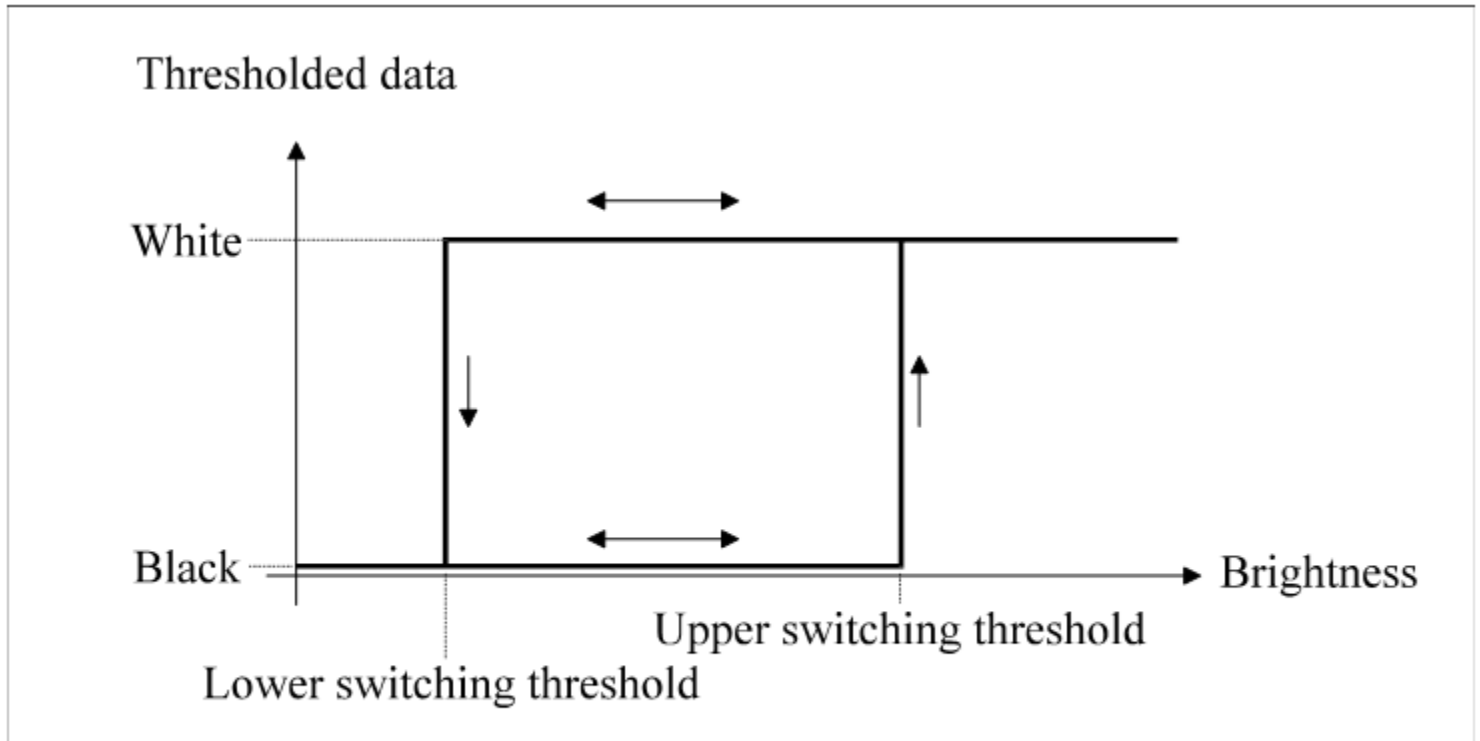
(c) thresholded magnitude

Applying the Sobel Operator

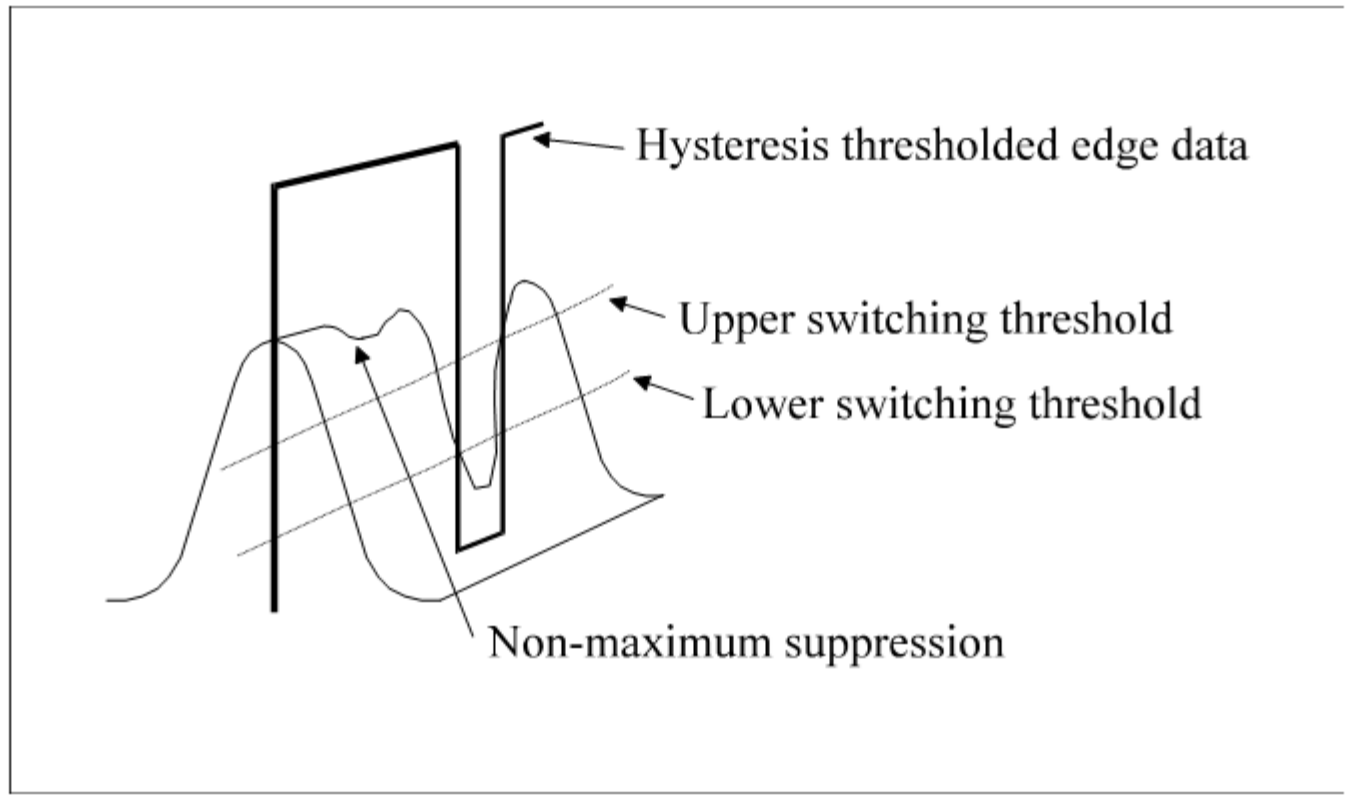
(a) Gaussian smoothing	**(b)** Sobel edge detection	**(c)** non-maximum suppression	**(d)** hysteresis thresholding
Stages in Canny Edge Detection			



Interpolation in Non-Maximum Suppression



Hysteresis Thresholding Transfer Function



Action of Non-Maximum Suppression and Hysteresis Thresholding

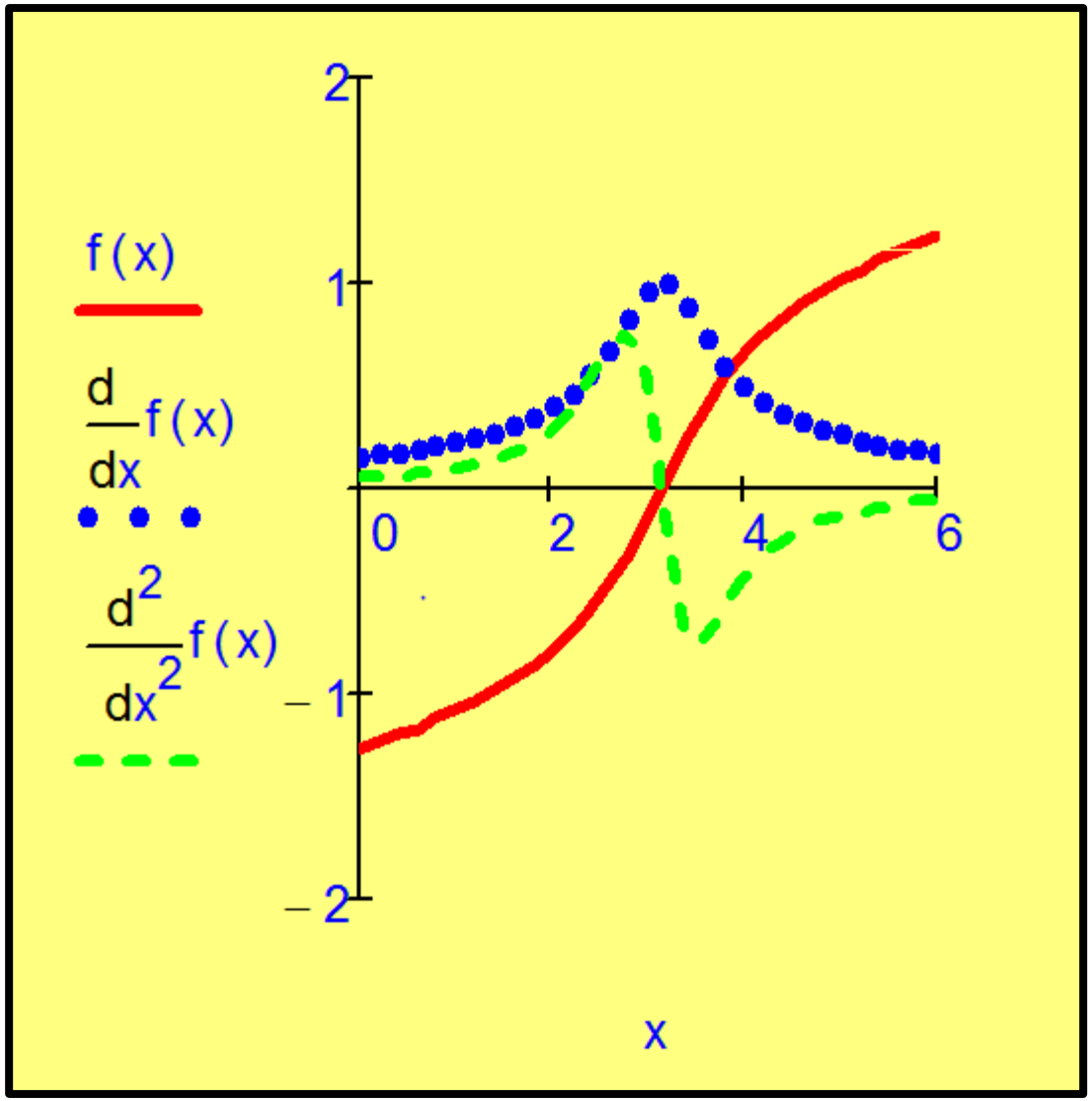
(a) hysteresis thresholding, upper level = 40, lower level = 10	**(b)** uniform thresholding, level = 40	**(c)** uniform thresholding, level = 10
Comparing Hysteresis Thresholding with Uniform Thresholding		

(a) original image

(b) Canny

(c) Sobel

Comparing Canny with Sobel


f(x)
d/dx f(x)
d^2/dx^2 f(x)
2
1
−1
−2
0
2
4
6
x

0	-1	0
-1	4	-1
0	-1	0

Laplacian Edge Detection Operator

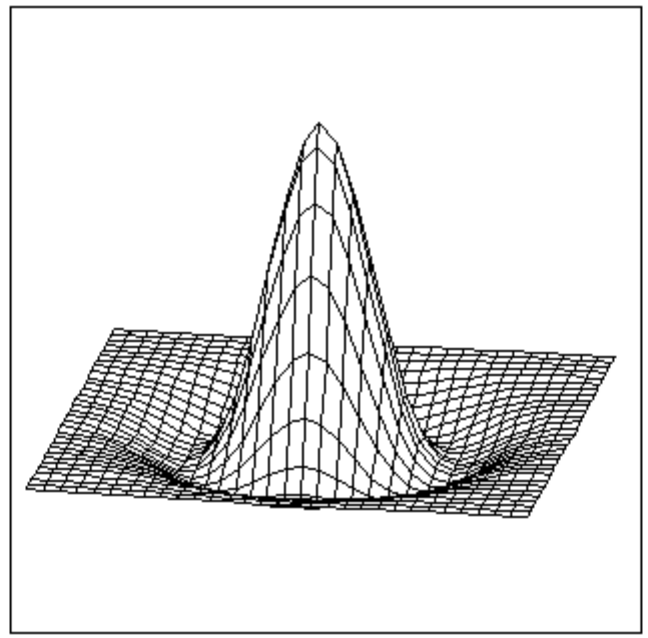
$$p = \begin{bmatrix} 1 & 2 & 3 & 4 & 1 & 1 & 2 & 1 \\ 2 & 2 & 3 & 0 & 1 & 2 & 2 & 1 \\ 3 & 0 & 38 & 39 & 37 & 36 & 3 & 0 \\ 4 & 1 & 40 & 44 & 41 & 42 & 2 & 1 \\ 1 & 2 & 43 & 44 & 40 & 39 & 1 & 3 \\ 2 & 0 & 39 & 41 & 42 & 40 & 2 & 0 \\ 1 & 2 & 0 & 2 & 2 & 3 & 1 & 1 \\ 0 & 2 & 1 & 3 & 1 & 0 & 4 & 2 \end{bmatrix}$$

(a) image data

$$L = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & -31 & -47 & -36 & -32 & 0 & 0 \\ 0 & -44 & 70 & 37 & 31 & 60 & -28 & 0 \\ 0 & -42 & 34 & 12 & 1 & 50 & -39 & 0 \\ 0 & -37 & 47 & 8 & -6 & 33 & -42 & 0 \\ 0 & -45 & 72 & 37 & 45 & 74 & -34 & 0 \\ 0 & 5 & -44 & -38 & -40 & -31 & -6 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

(b) after Laplacian operator

Edge Detection via the Laplacian Operator

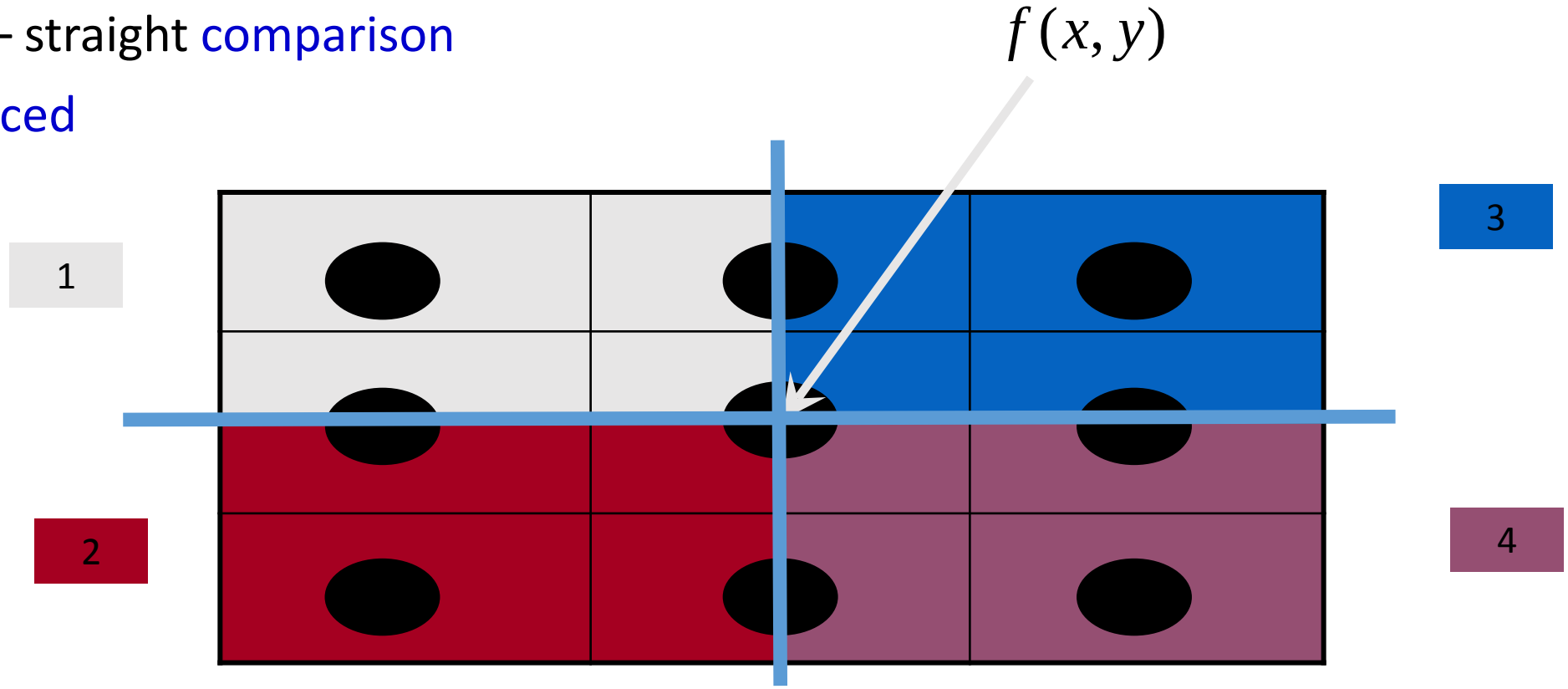


LoG(4 , 31)

Shape of Laplacian of Gaussian Operator

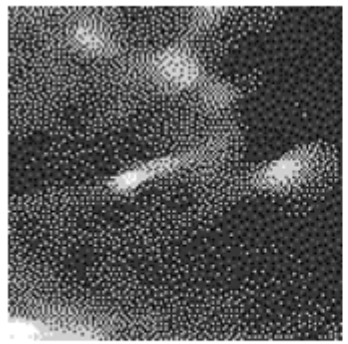
Zero Crossing Detection

- Basic – straight comparison
- Advanced

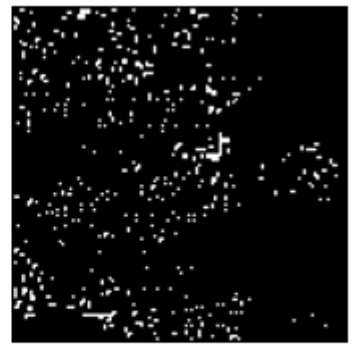


$$IF\ \left(\max(1,2,3,4) > 0 \wedge \min(1,2,3,4) < 0\right)\quad THEN\quad f(x,y) = \text{edge}$$

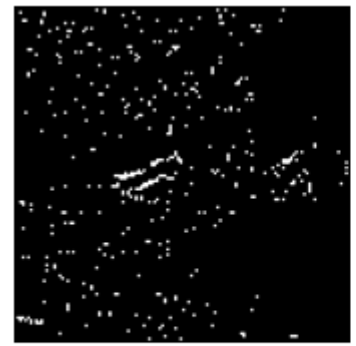
(a) face image	**(b)** 11×11 LoG	**(c)** 15×15 LoG
Marr-Hildreth Edge Detection		



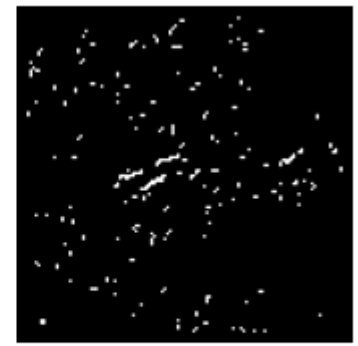
(a) original image



(b) first order



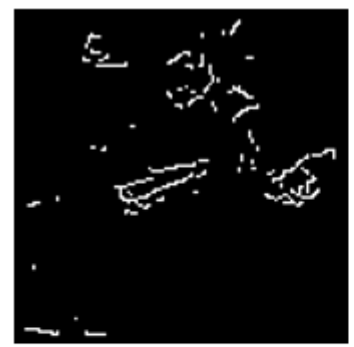
(c) Prewitt



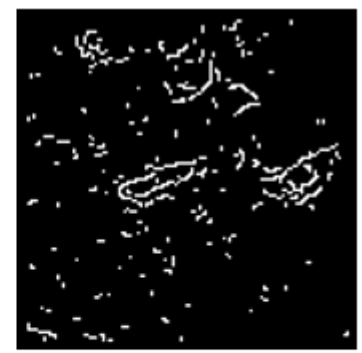
(d) Sobel

(e) Laplacian

(f) Marr-Hildreth



(g) Canny



(h) Spacek

Comparison of Edge Detection Operators