Image Segmentation

Image Processing

CSE 166

Lecture 16

Reading

- Digital Image Processing, 4th edition
  - Chapter 10: Image segmentation I: edge detection, thresholding, and region detection

Image segmentation

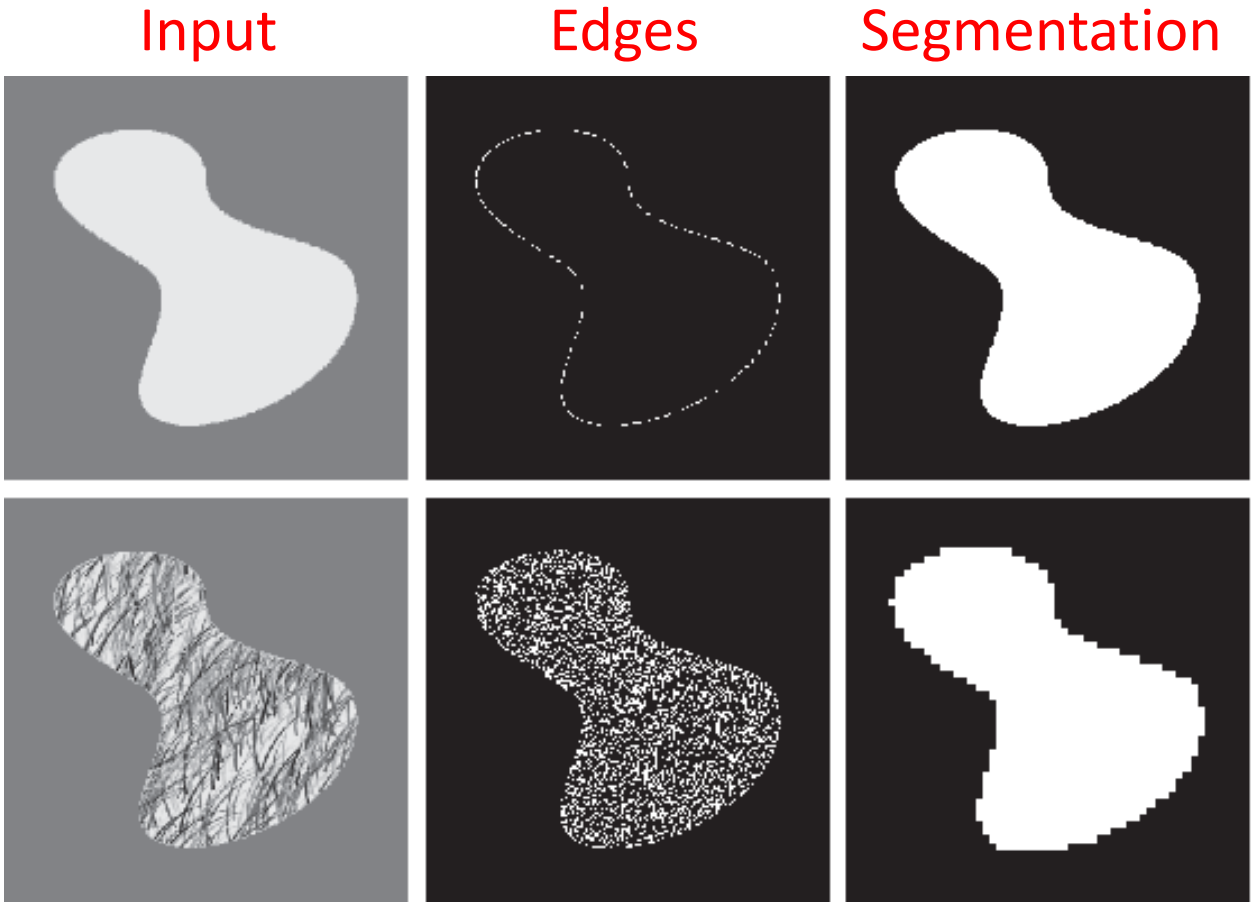
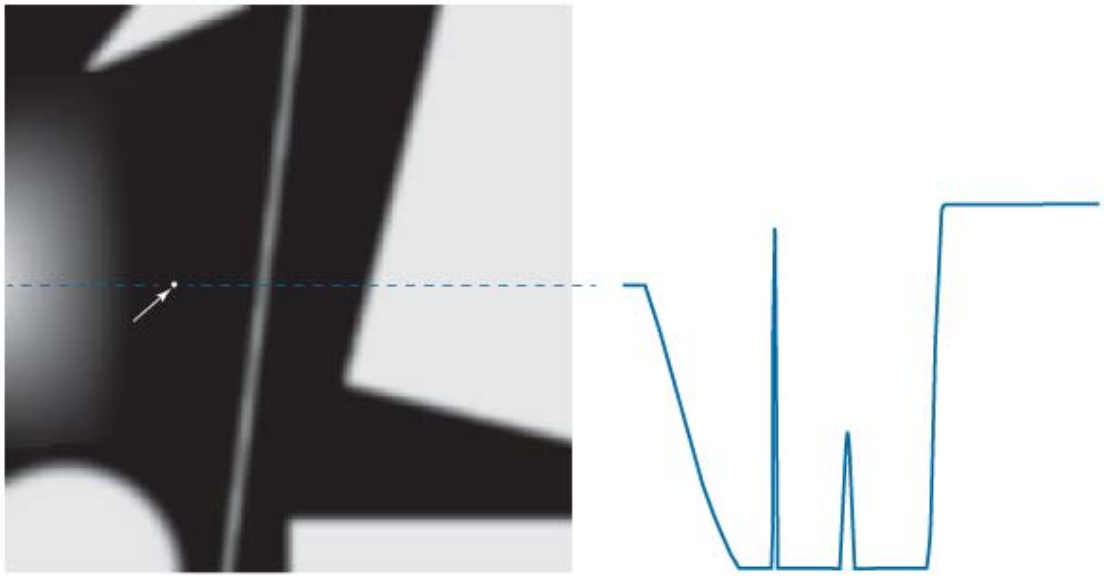
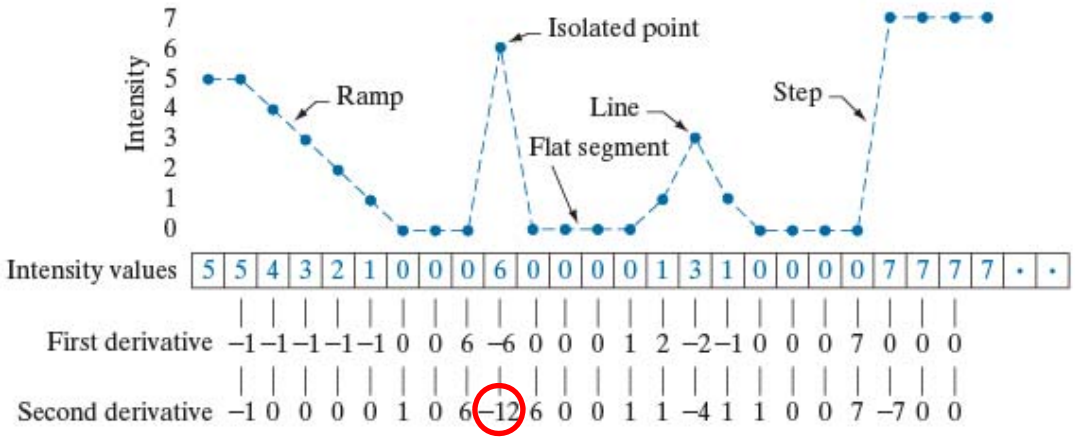


Image derivatives

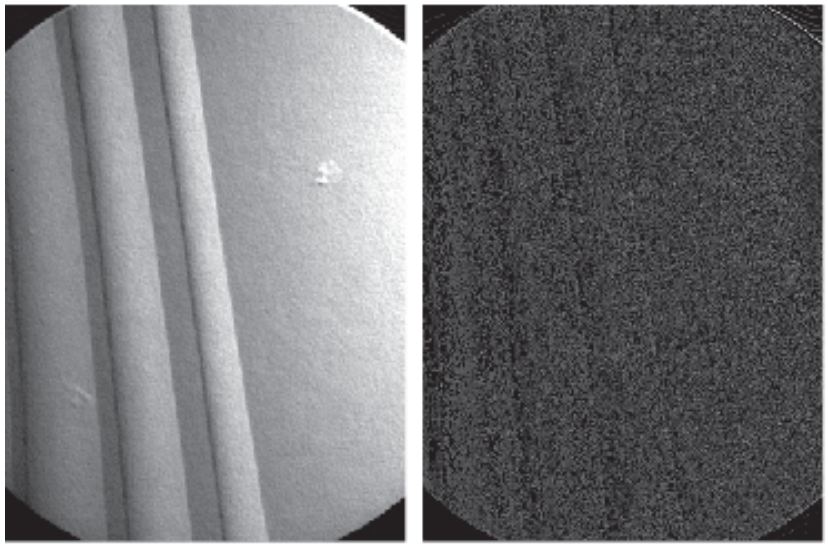


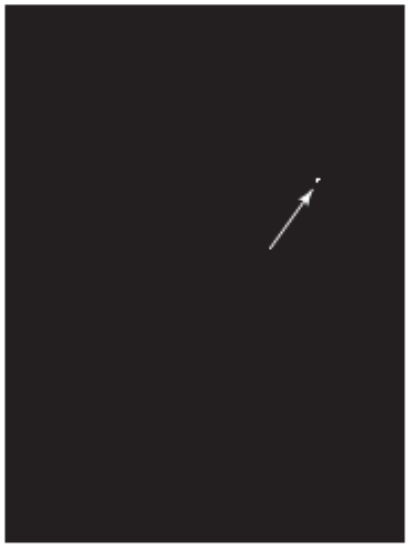


Detection of isolated points

1	1	1
1	−8	1
1	1	1

Laplacian
(second derivative)



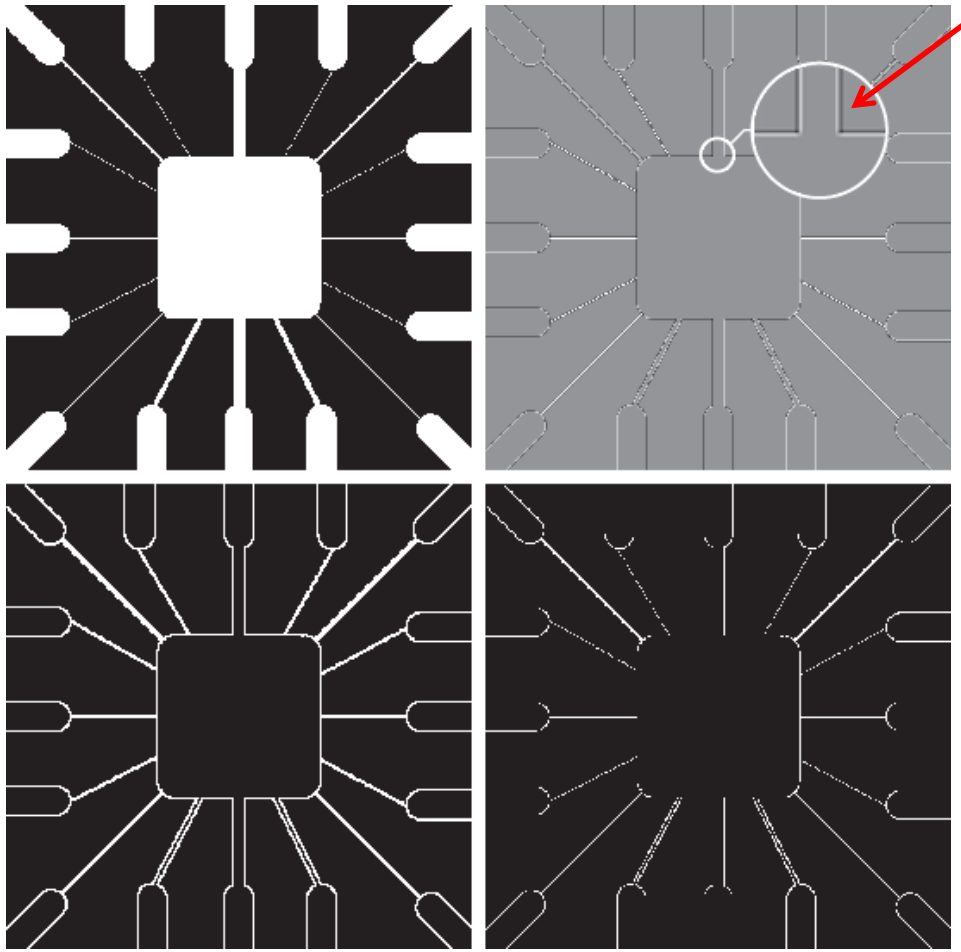


Threshold
absolute
value

Input

Segmentation

Line detection



Line detection, specific directions

−1	−1	−1
2	2	2
−1	−1	−1

Horizontal

2	−1	−1
−1	2	−1
−1	−1	2

+45°

−1	2	−1
−1	2	−1
−1	2	−1

Vertical

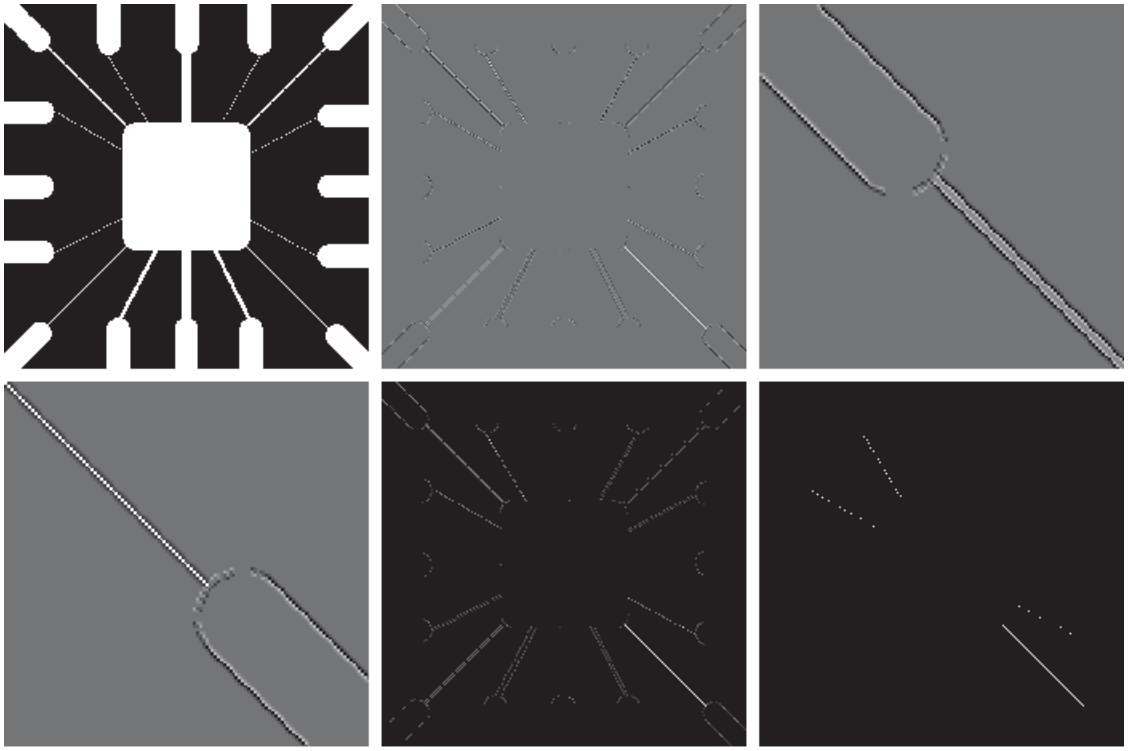
−1	−1	2
−1	2	−1
2	−1	−1

−45°

Spatial filters

Line detection, specific directions

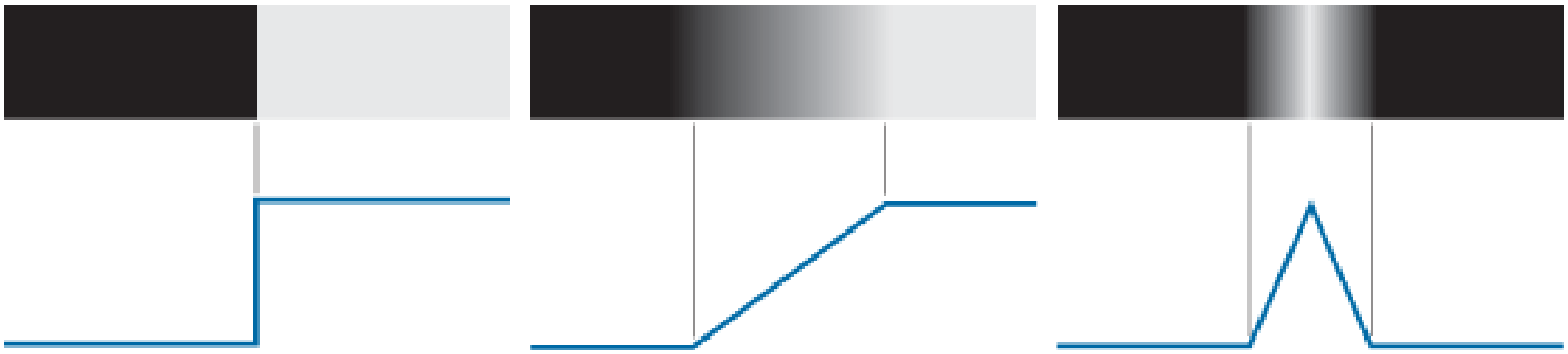
+45°



Negative values set to zero

Threshold

Edge models

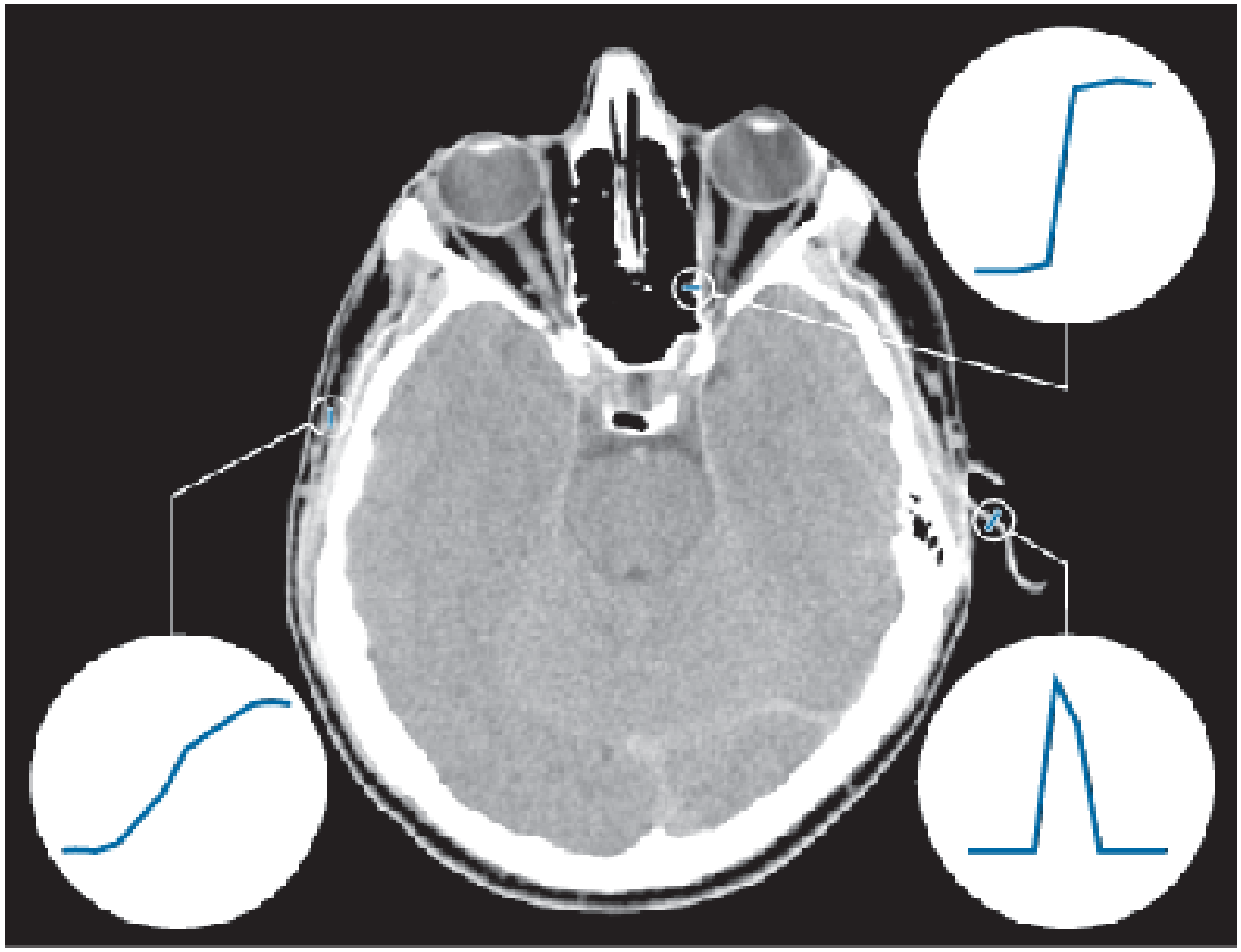


Step

Ramp

Roof edge

Edge models

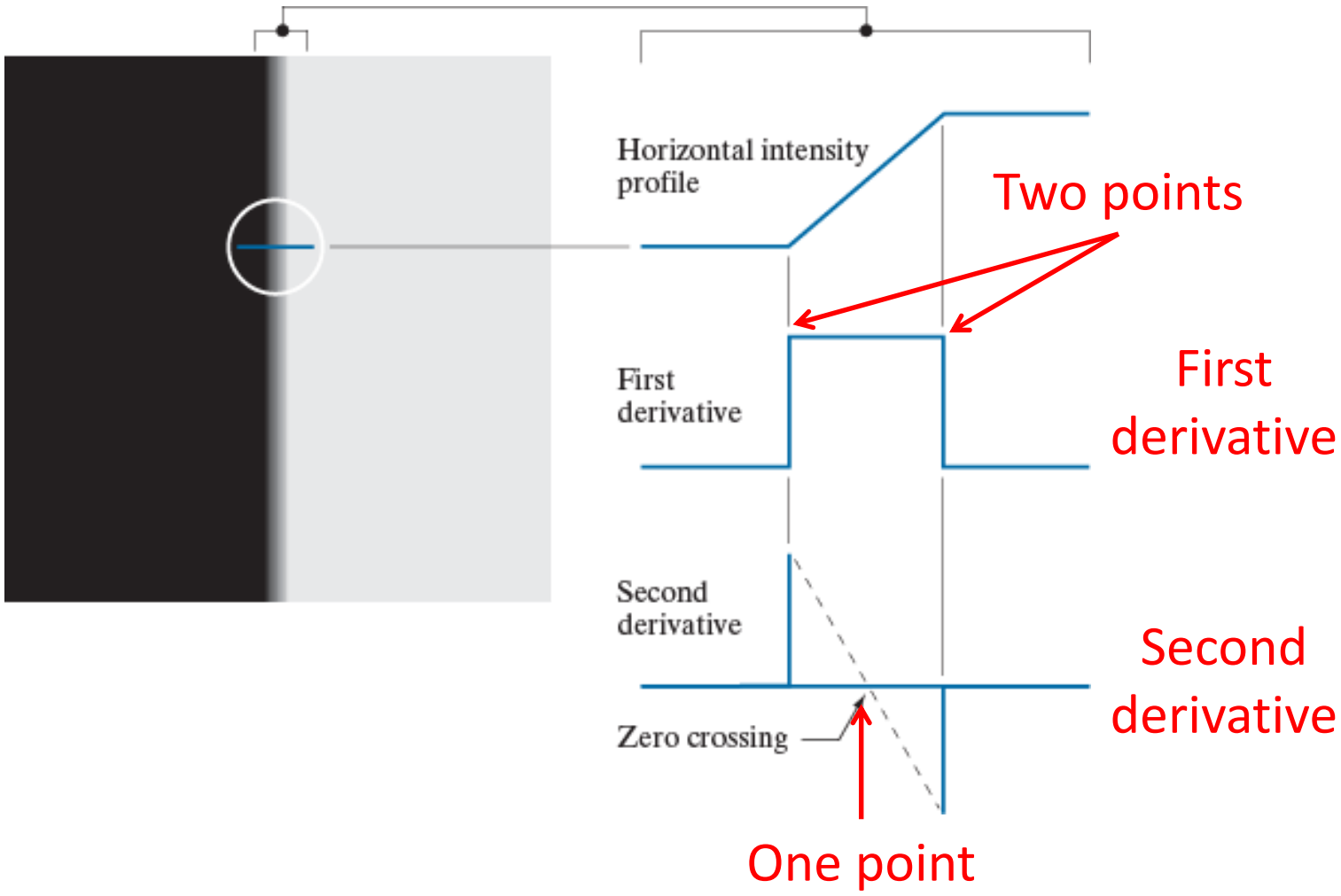


Step

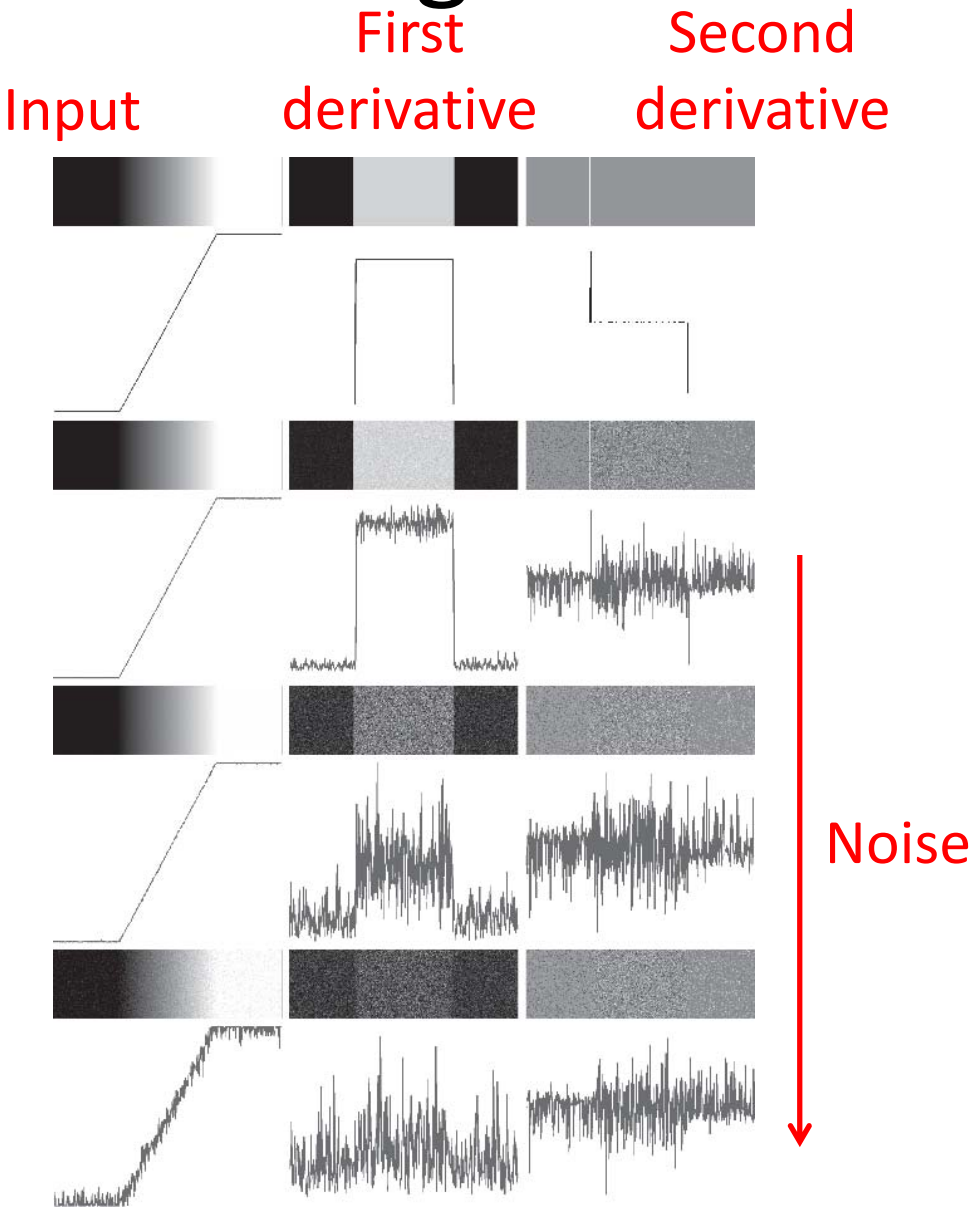
Ramp

Roof edge

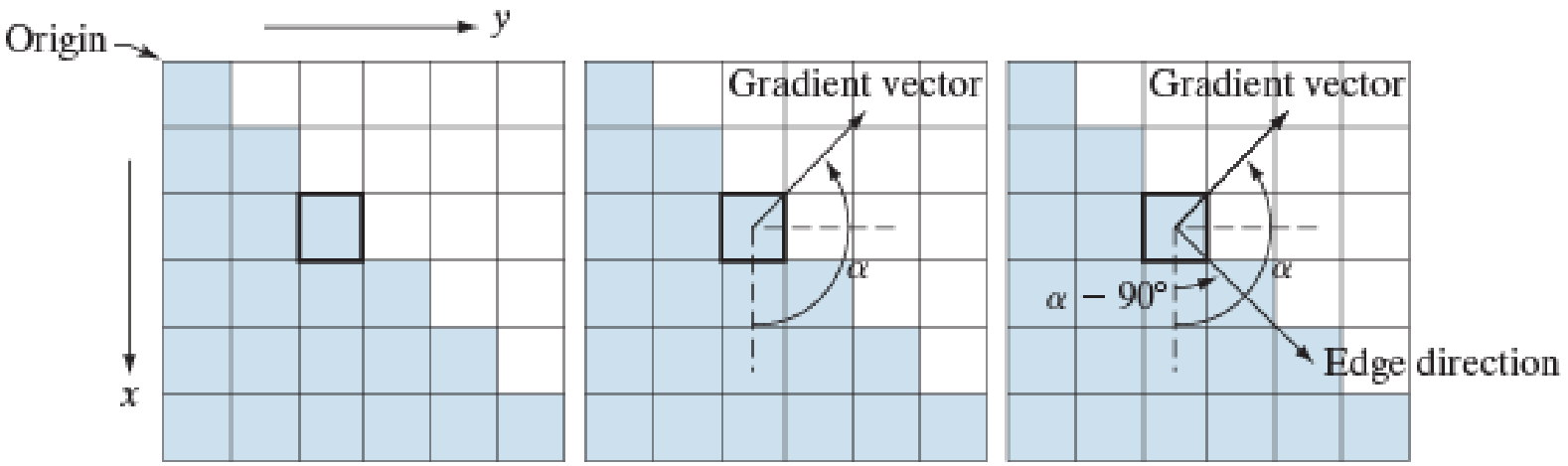
Ramp edge


Horizontal intensity profile
Two points
First derivative
First derivative
Second derivative
Second derivative
Zero crossing
One point

Noise and image derivatives



Gradient and edge direction



Gradient direction is orthogonal to edge direction

Gradient operators

−1	
1	

−1	1

Forward difference

−1	0	
0	1	

0	−1
1	0

Roberts

−1	−1	−1
0	0	0
1	1	1

−1	0	1
−1	0	1
−1	0	1

Prewitt

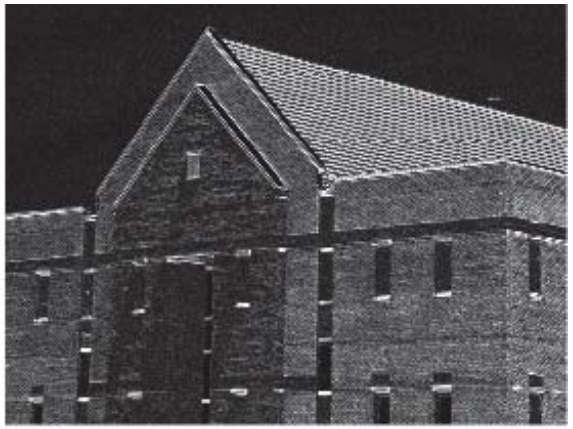
−1	−2	−1
0	0	0
1	2	1

−1	0	1
−2	0	2
−1	0	1

Sobel

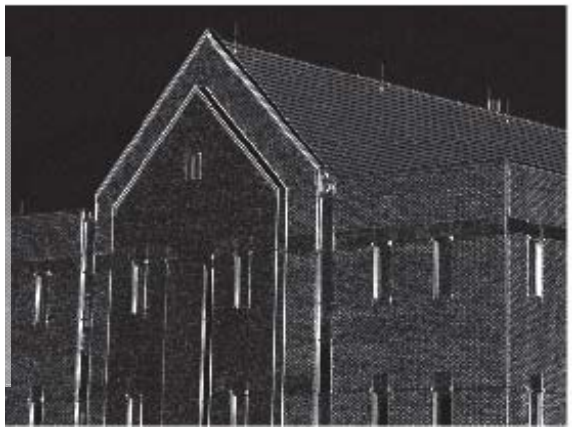
Gradients

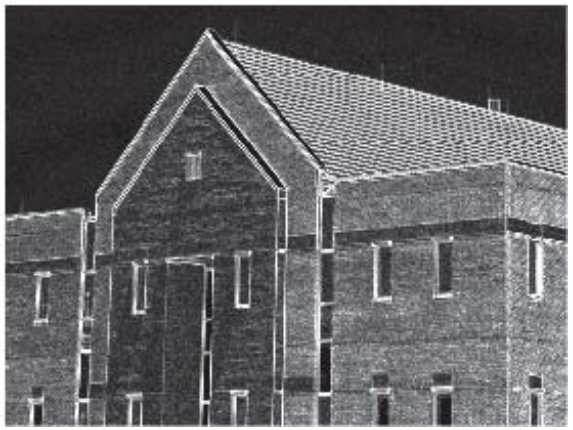
Input



Magnitude of vertical gradient

Magnitude of horizontal gradient





Magnitude of gradient vector

Gradients

Smooth image prior to computing gradients.
Results in more selective edges

Input

Magnitude of vertical gradient

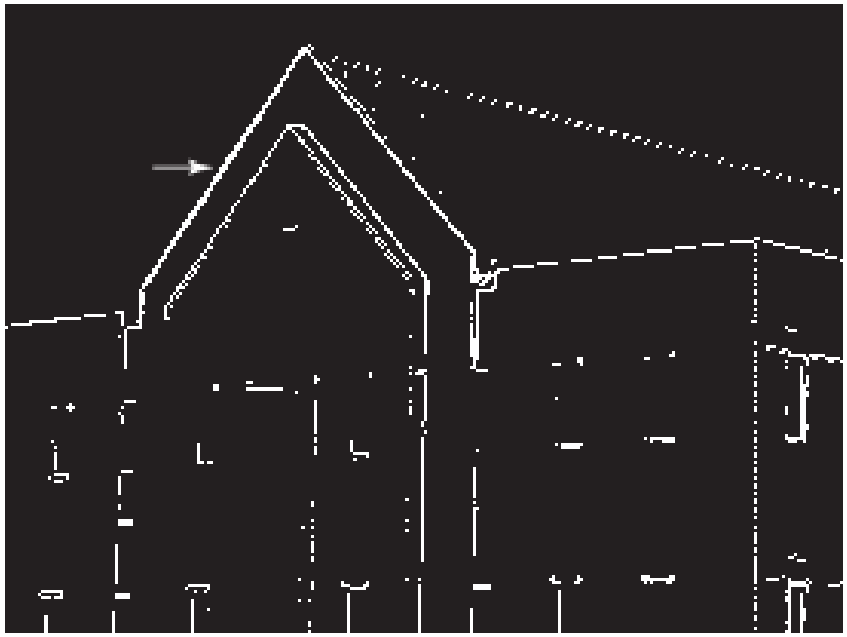
Magnitude of horizontal gradient

Magnitude of gradient vector

Edge detection

Threshold magnitude of gradient vector

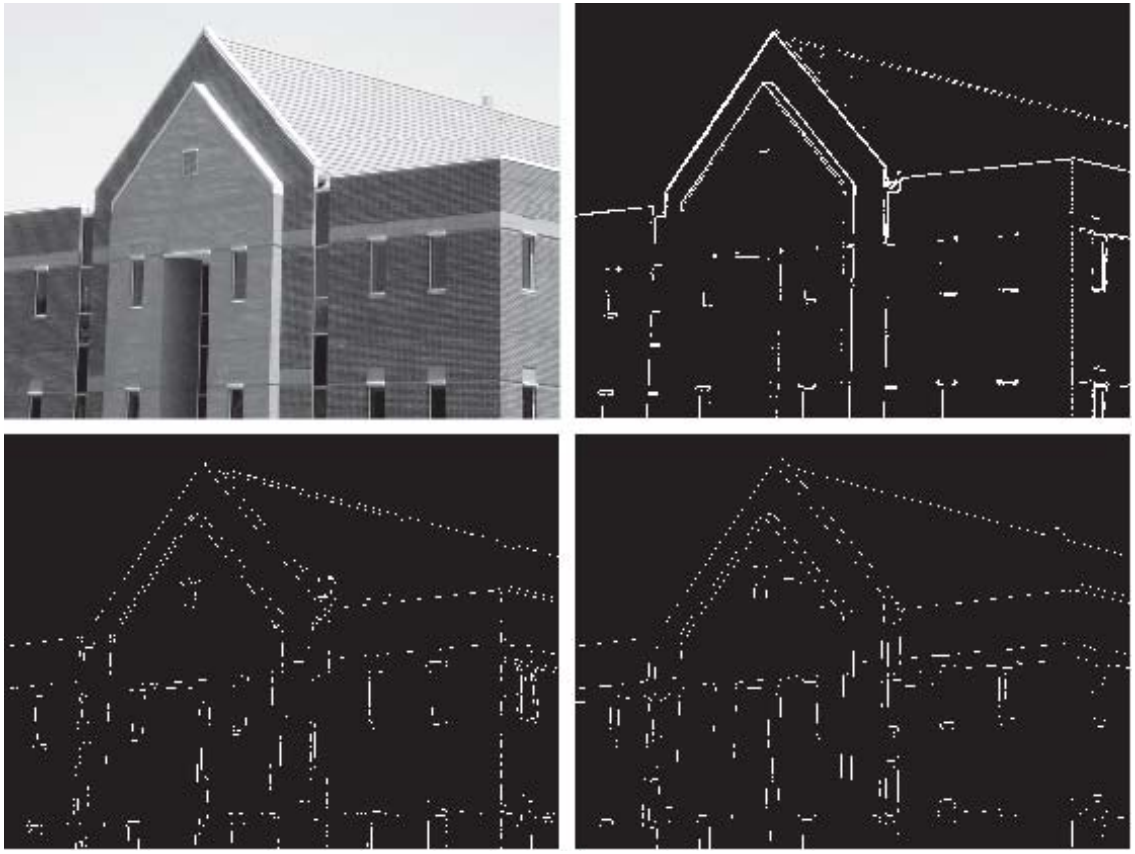
Without smoothing



With smoothing

Advanced edge detection

Input



Magnitude of gradient vector (with smoothing)

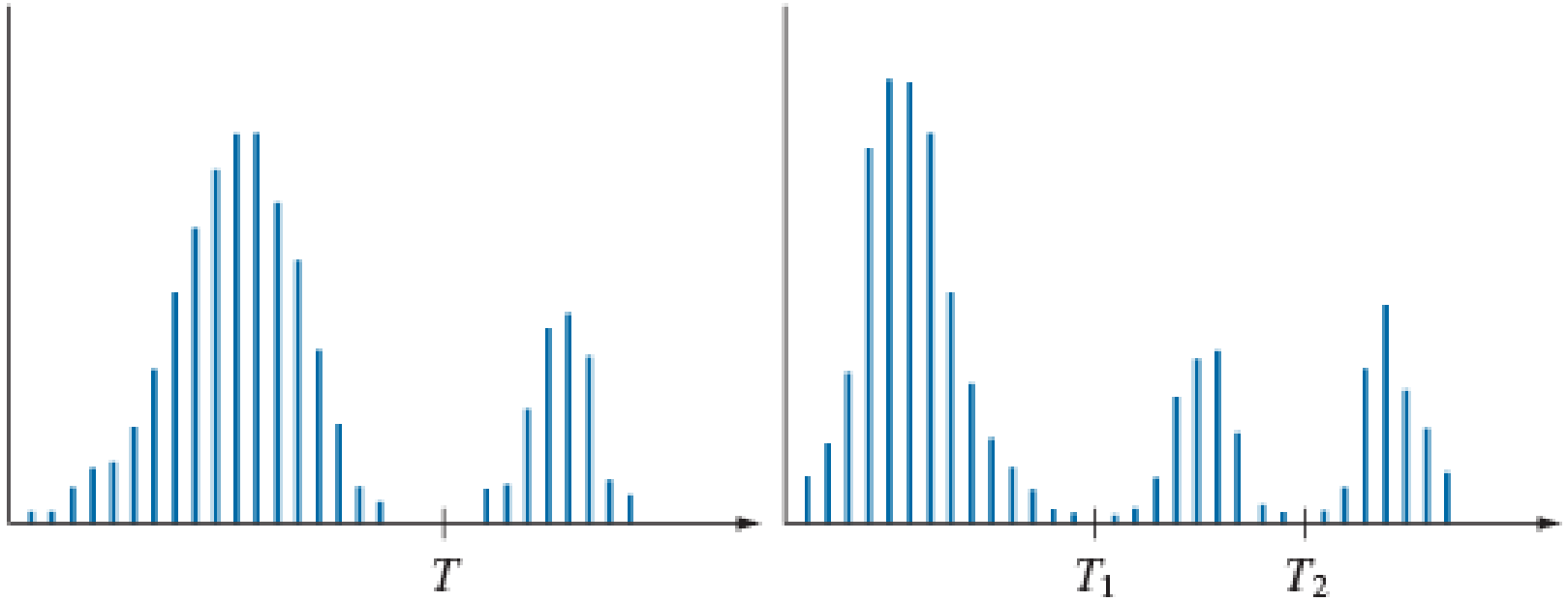
Marr-Hildreth

Canny

See textbook for algorithms

Thresholding

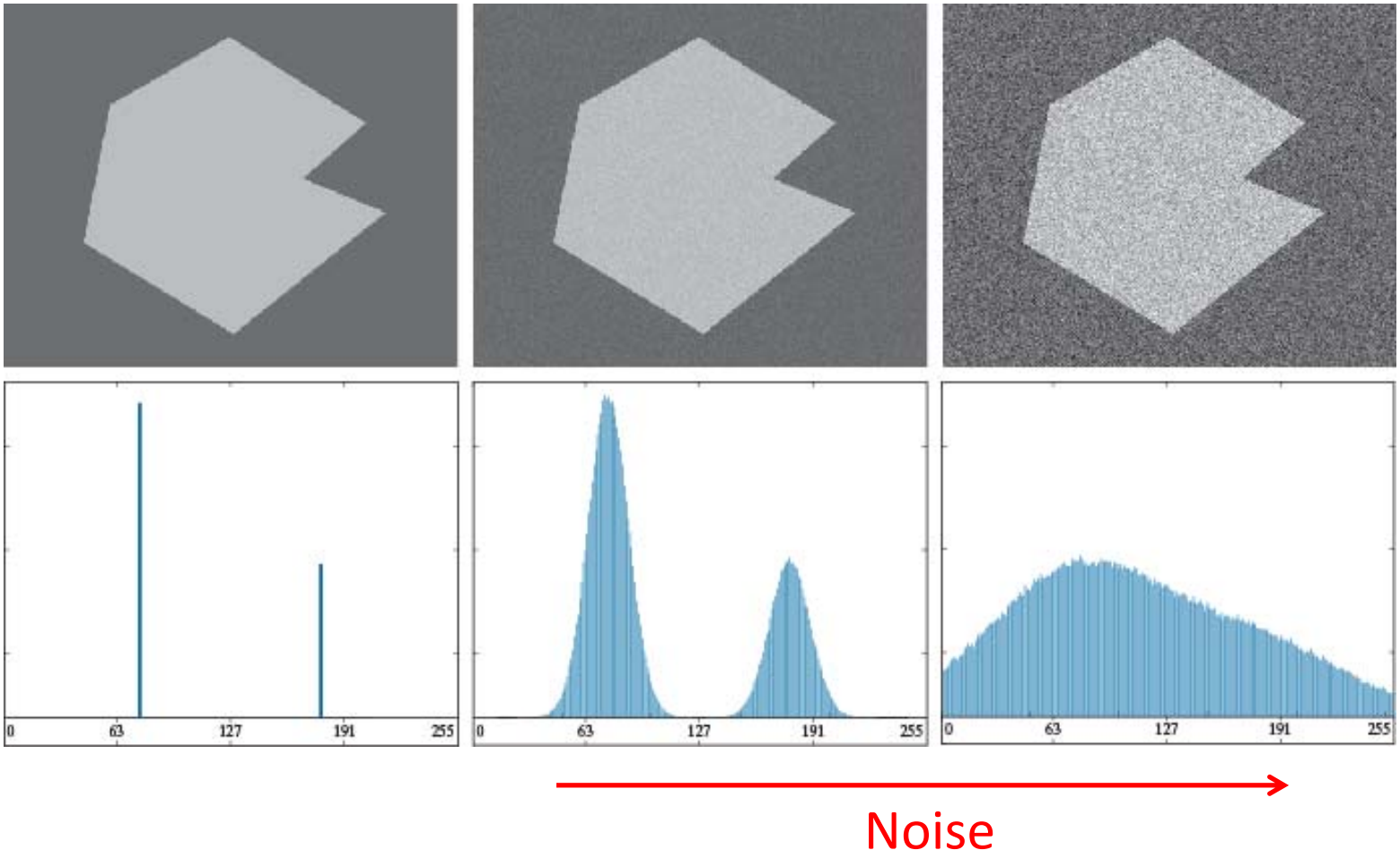
Histograms



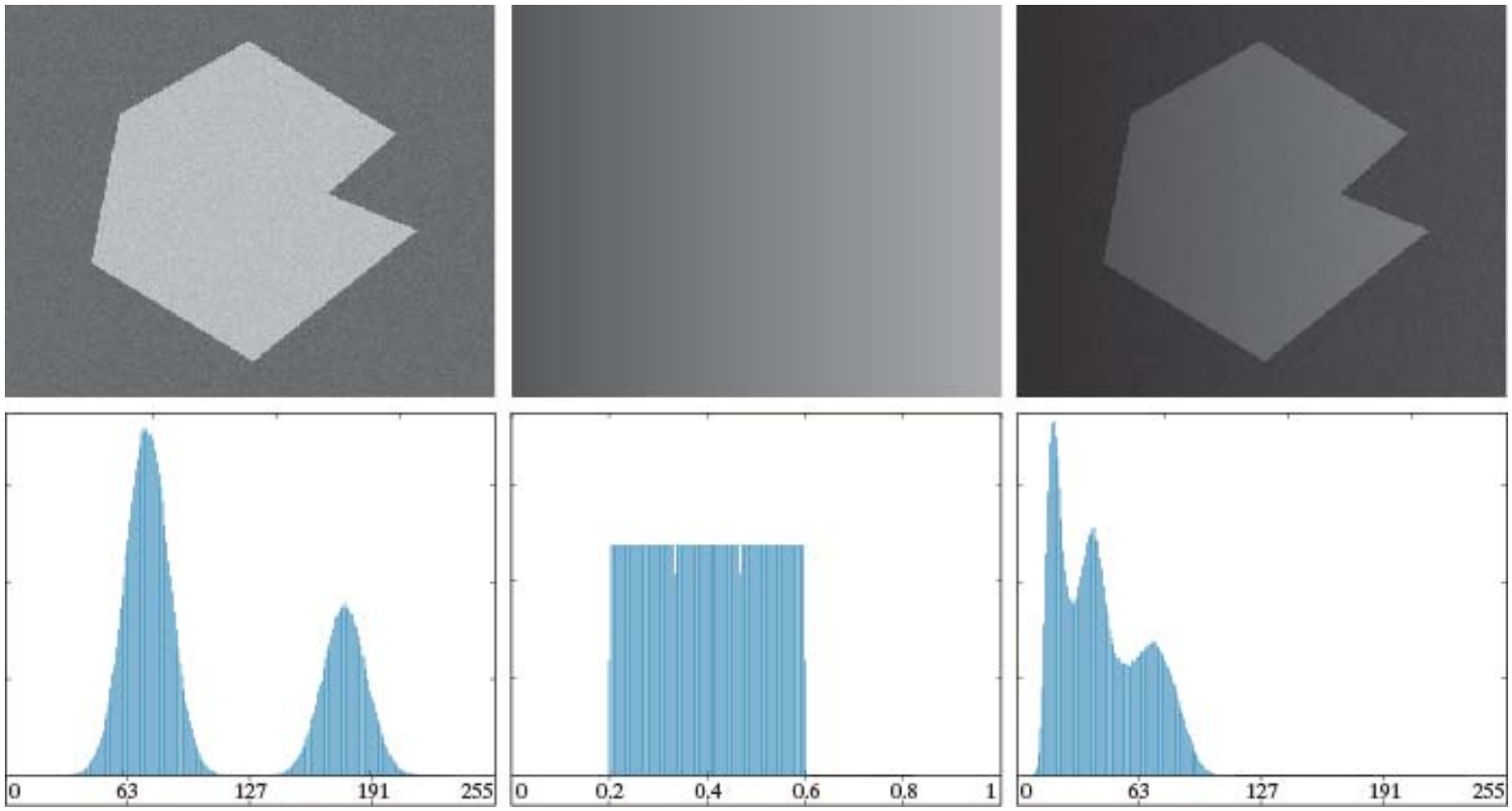
Single threshold

Dual threshold

Noise and thresholding



Varying background and thresholding



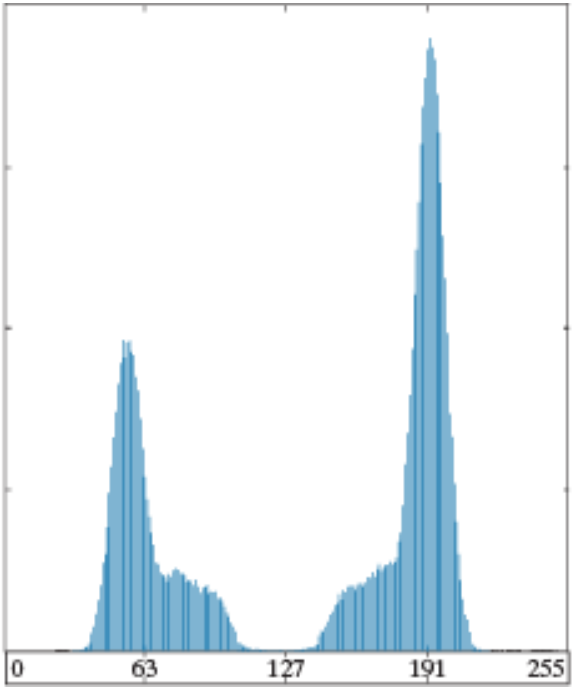
Input

Intensity ramp

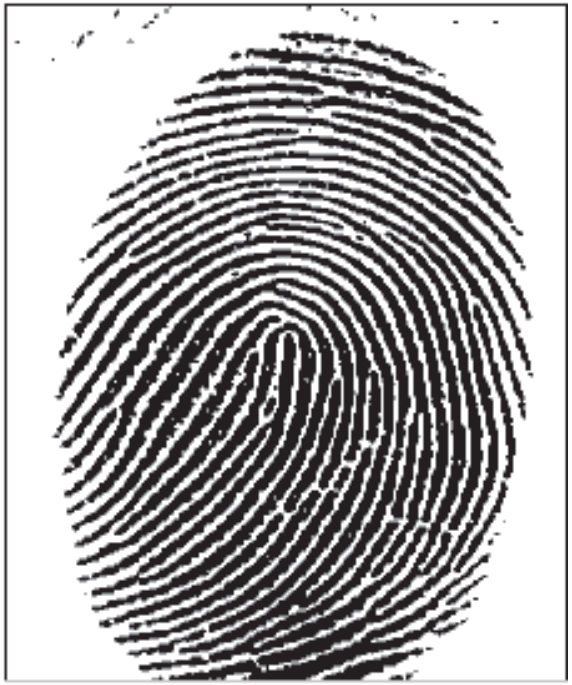
Product of input and intensity ramp

Basic global thresholding

Input



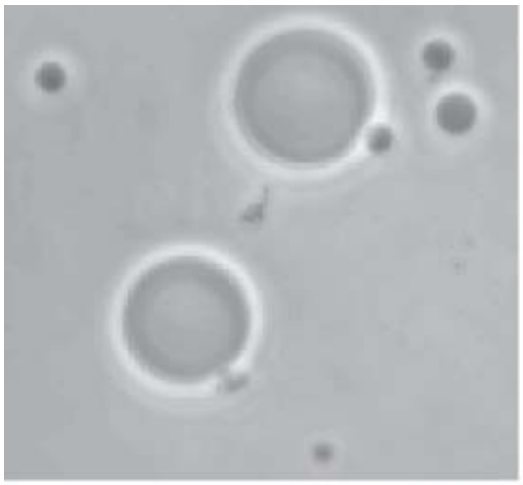
Intensity ramp

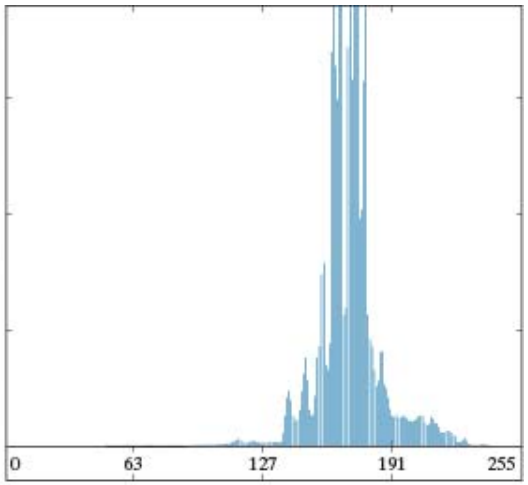


Threshold

Optimum global thresholding

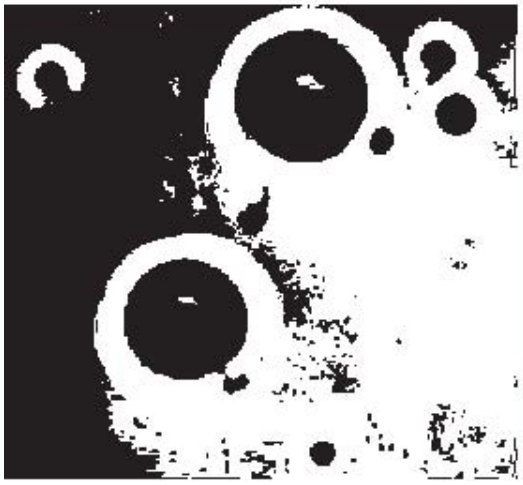
Input





Histogram

Basic global thresholding



Optimum global thresholding using Otsu's method

Optimum global thresholding