Chapter 7
Image Processing
Edge Detection
Lecture *Digital Image Processing,* March. 12th, 2010

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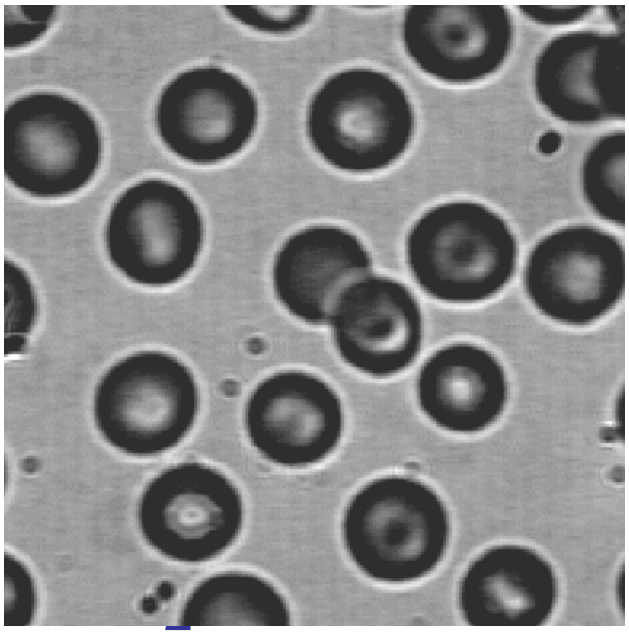
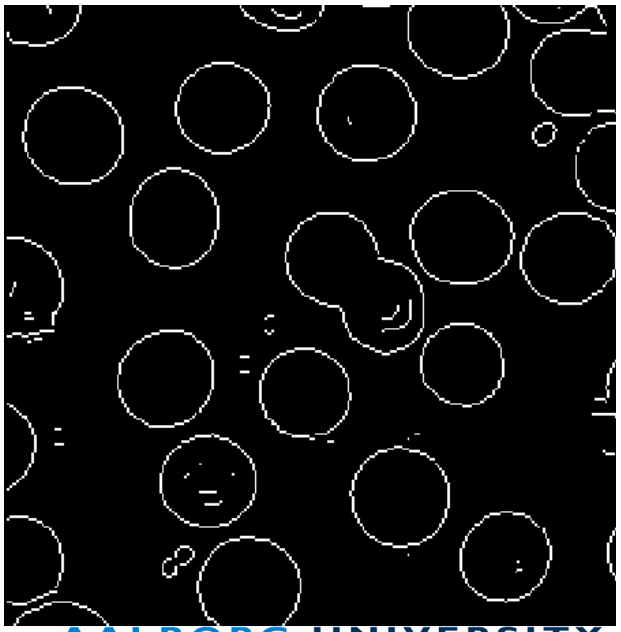
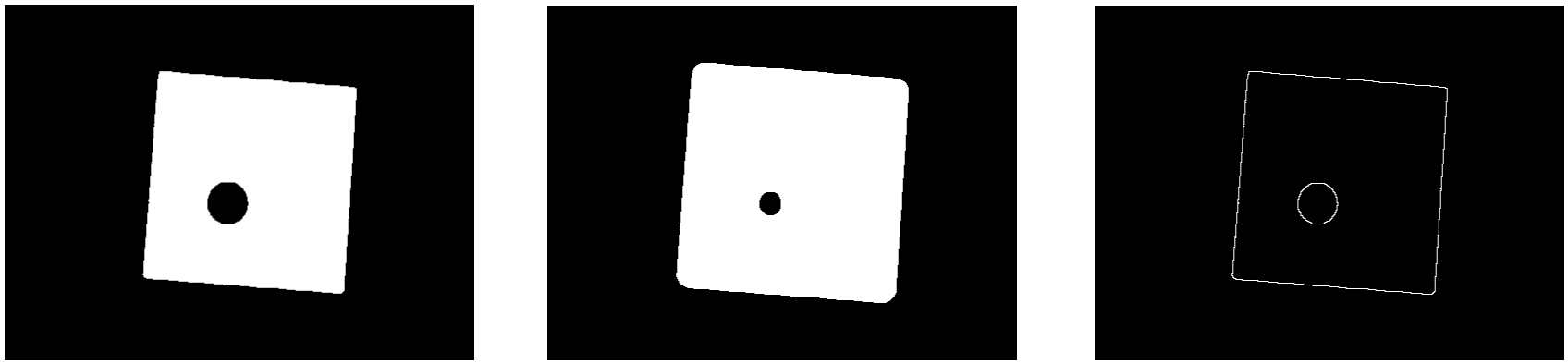
What are edges?



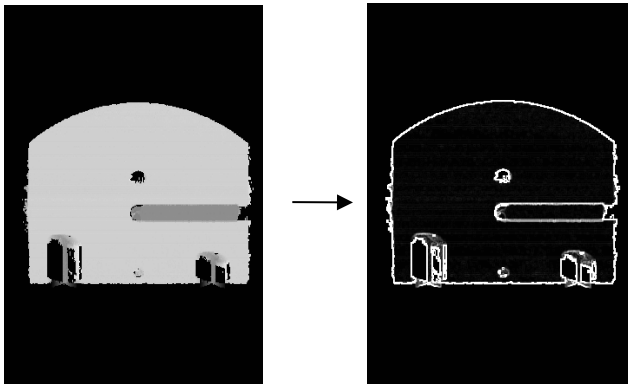
Edge detection

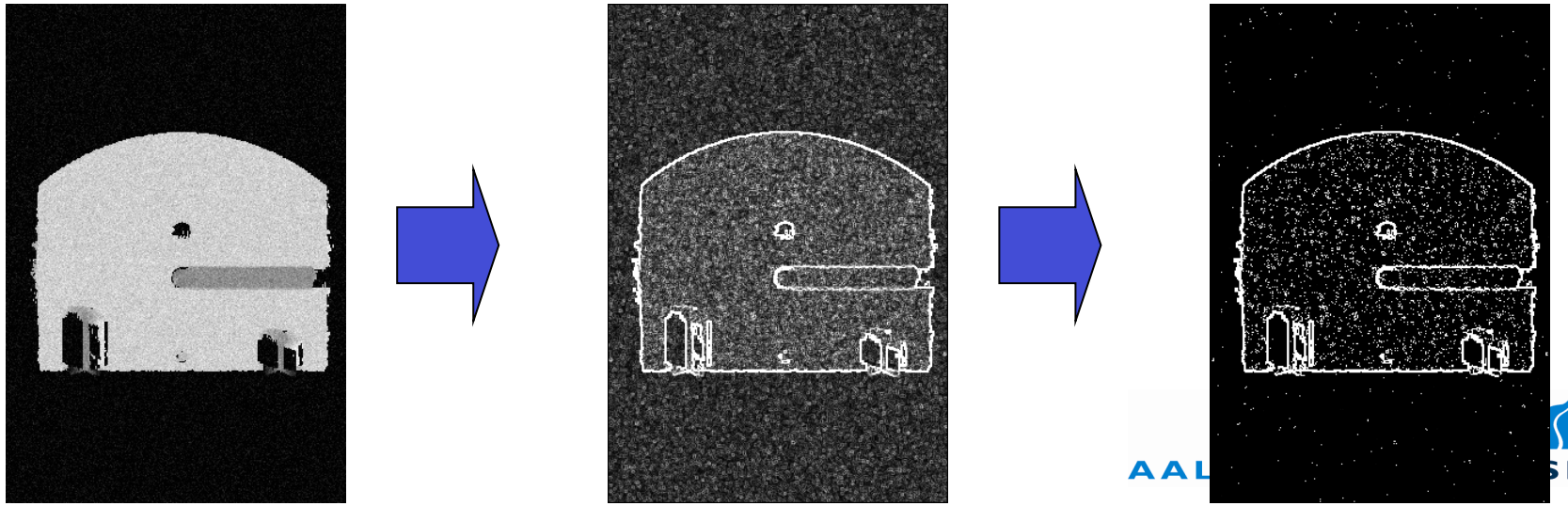


How do we find them?



Edges detectors
The Noise Problem

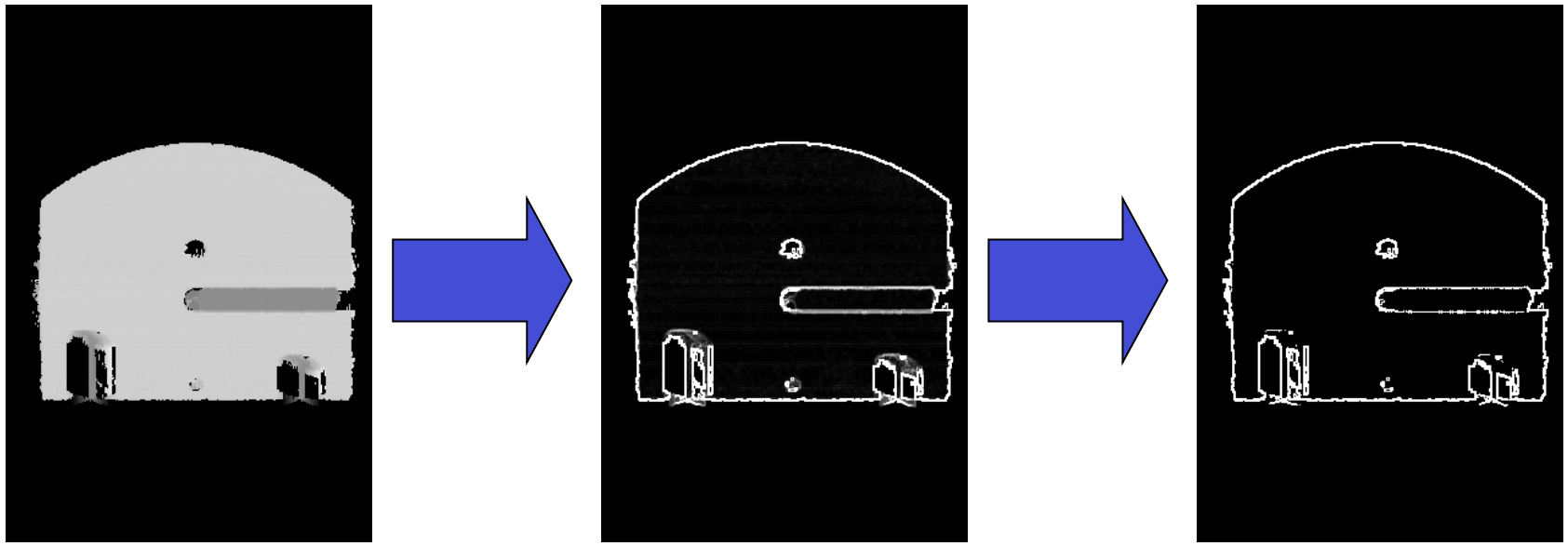




Example for Sobel Operator

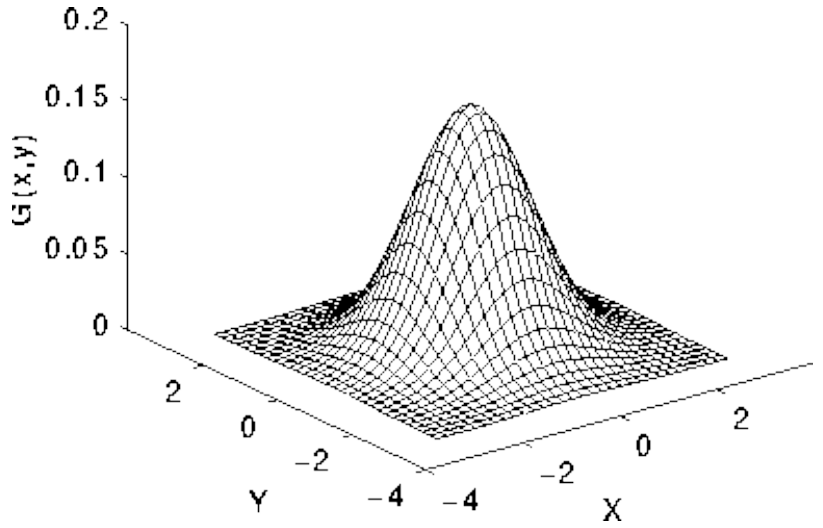
Example for Sobel Operator

- Threshold: 150

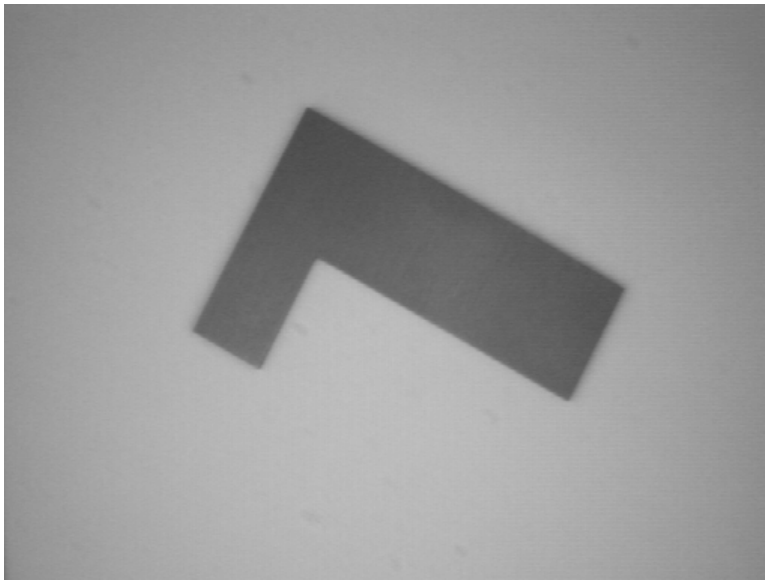


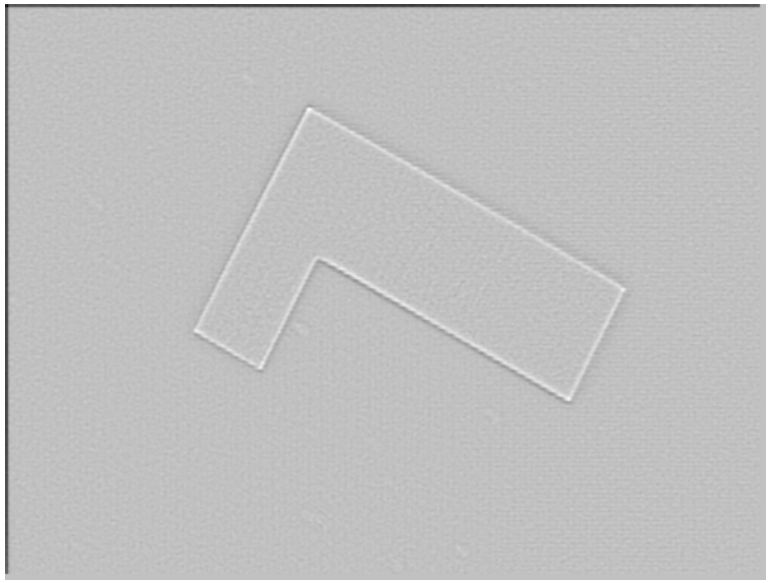
Laplacian of Gaussian

- 2D Gaussian
- Used for smoothing



Example for the LoG



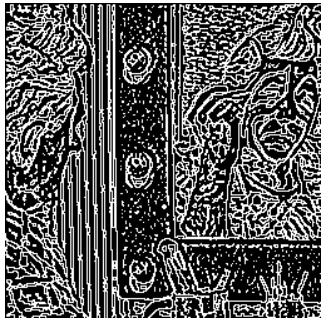


Examples of LoG

Gauss filter width:

5x5 pixels



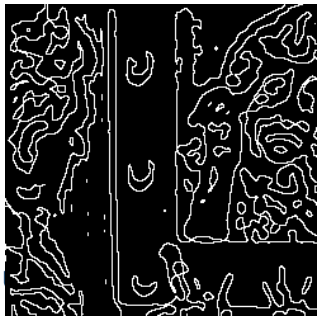


9x9 pixels

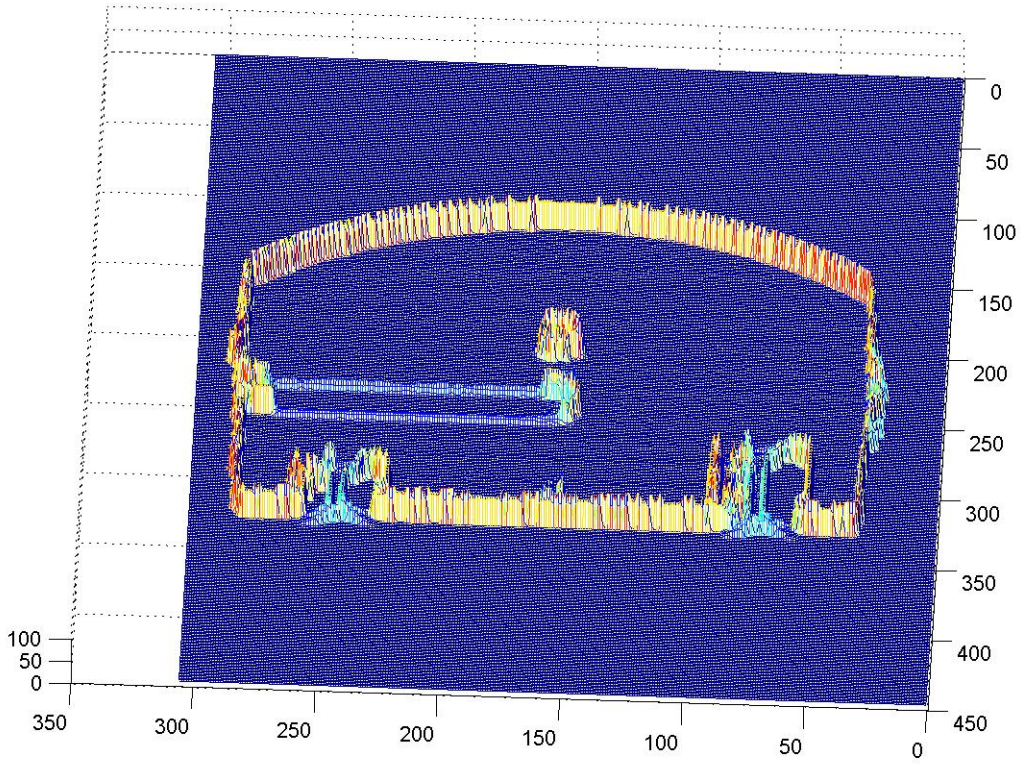


12x12 pixels

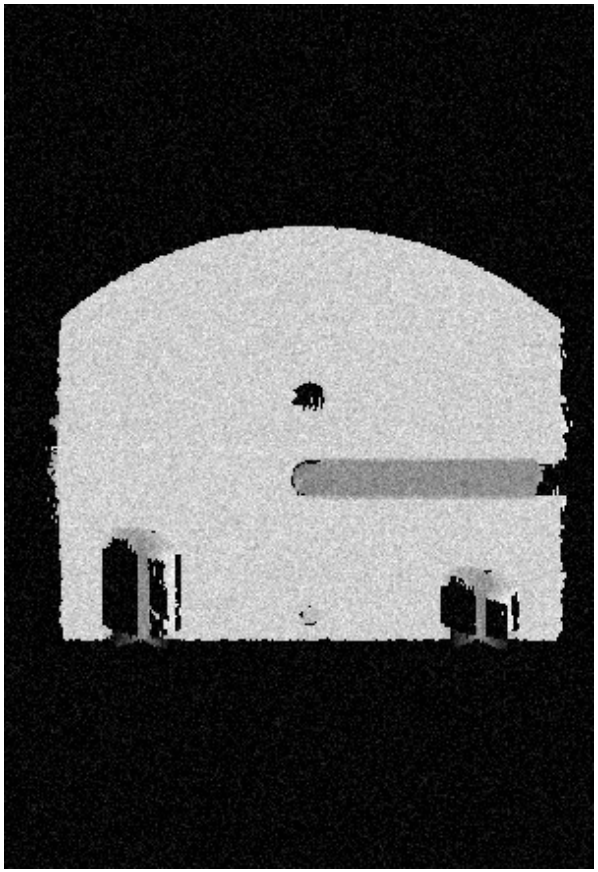


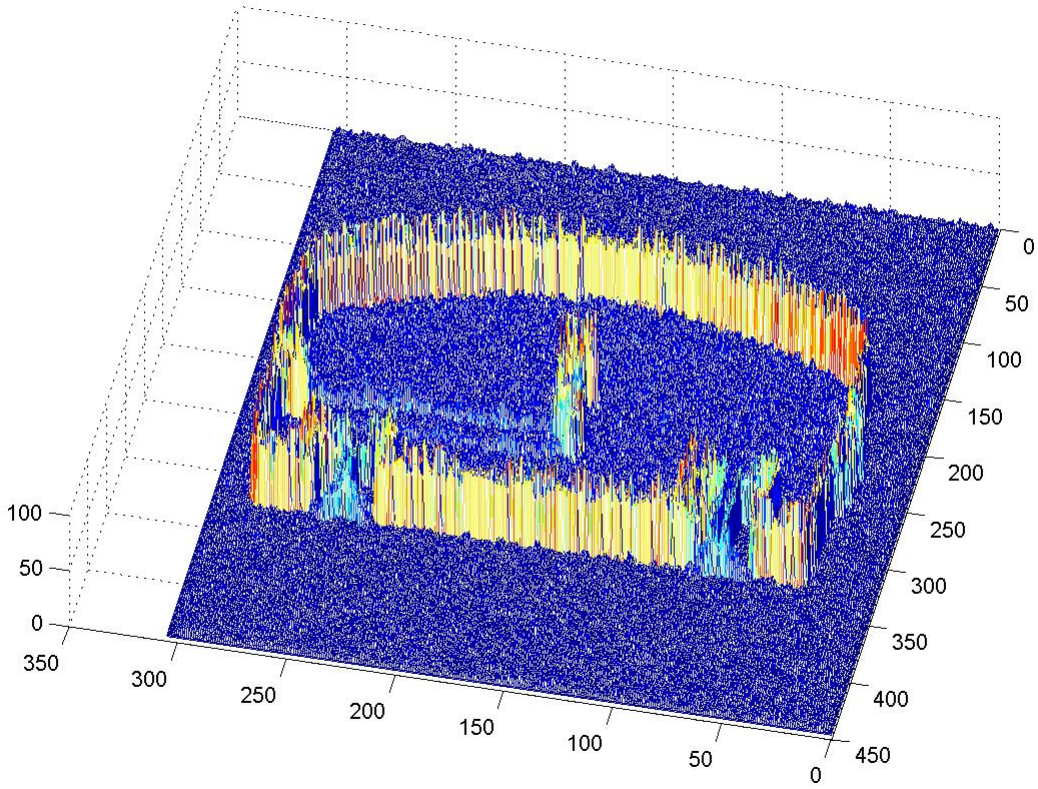


Example: 1st Derivative



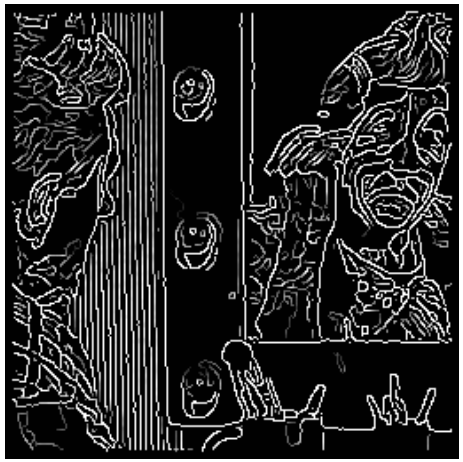
Example: 1st Derivative of Noisy Image





Examples

Gauss 5x5,
$Th_{max} = 128$,
$Th_{min} = 1$



Gauss 5x5,
$Th_{max} = 255$,
$Th_{min} = 1$

Gauss 5x5,
$Th_{max} = 255$,
$Th_{min} = 220$

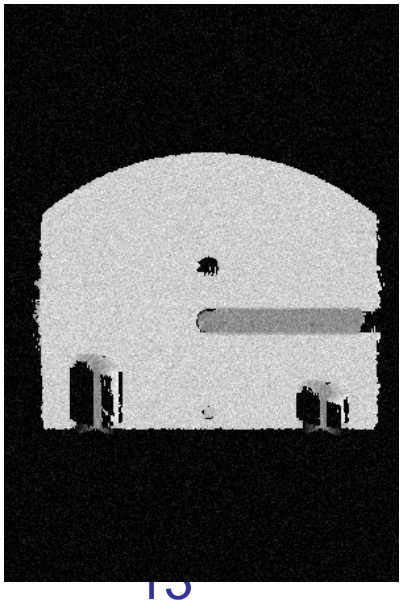
Gauss 9x9,
$Th_{max} = 128$,
$Th_{min} = 1$

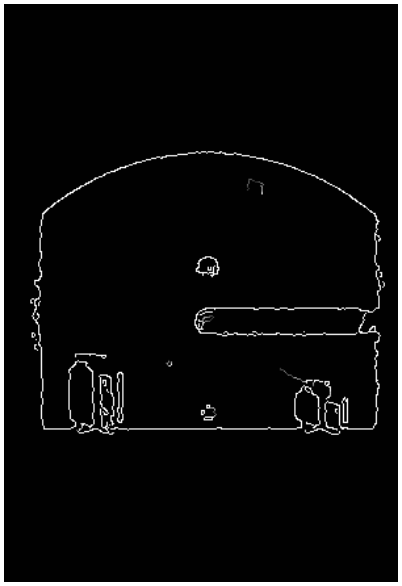
Examples

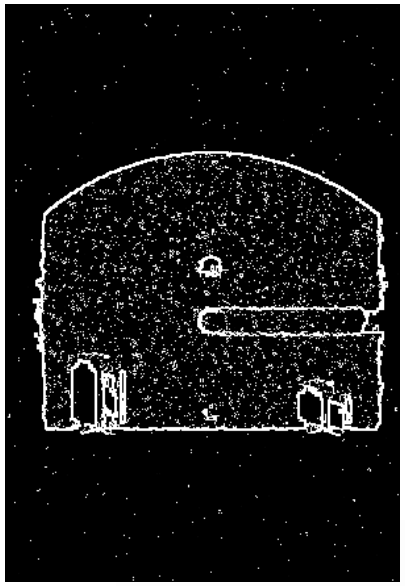
- Comparison on noisy image

Canny

Sobel



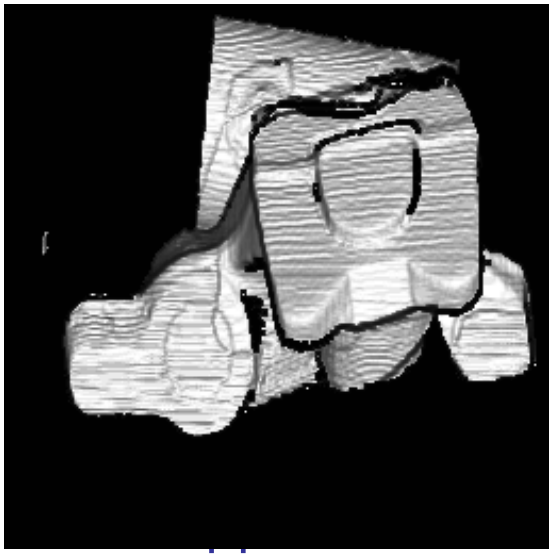


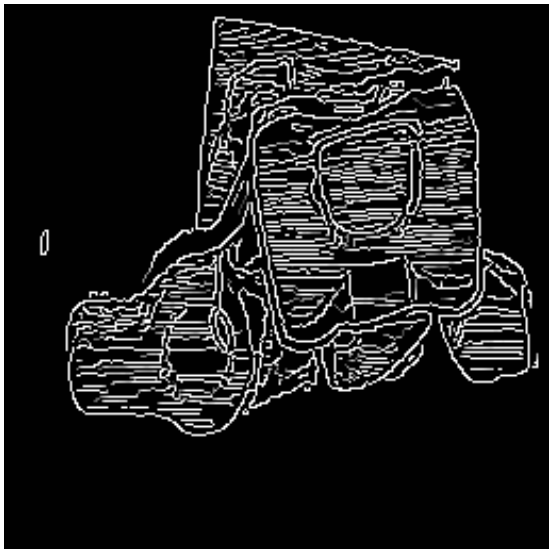


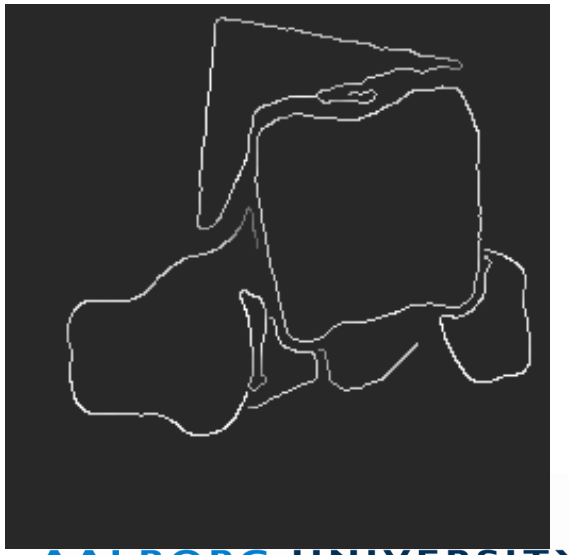
Examples

Gauss 5x5,
$Th_{max} = 200$,
$Th_{min} = 1$

Gauss 7x7,
$Th_{max} = 200$,
$Th_{min} = 1$







What to remember

- Edge = Rapid intensity (color) change
- Edge information is one of the most important in CV and Human Vision
- Three steps in edge detection:
  - Noise reduction
  - Edge enhancement
  - Edge localisation
- Three types were presented:
  - Based on first-order derivative
    - Prewitt and Sobel
  - Based on second-order derivative
    - Laplacian of Gaussian
  - Based on groups of edges
    - Canny

Exercises

- Questions to the lecture?
- What was good about the lecture and what could have been better?
- Discuss the questions
- Discuss the principle of: non-maximal suppression
- Use C++/Matlab to generate a magnitude image using the Sobel kernels

Questions

- Explain the relationship between image derivatives and edge detection
- What is the advantage of using the first/second derivative for edge detection?
- What filters are used to compute the first/ second derivatives?
- what are the edge detection problems that are solved by the Canny edge detector?
- Explain in your own words how the Canny edge detector works.