

Computer Vision

Process of Edge Detection

- ▶ Edge detection is the most common approach for detecting meaningful discontinuities.
 - ▶ An edge is a set of connected pixels that lie on the boundary between two regions.
 - ▶ Edge detection is commonly used for image segmentation in computer vision tasks (e.g. face recognition)
- ▶ The magnitude of the first derivative in a particular direction can be used to detect the presence of an edge.

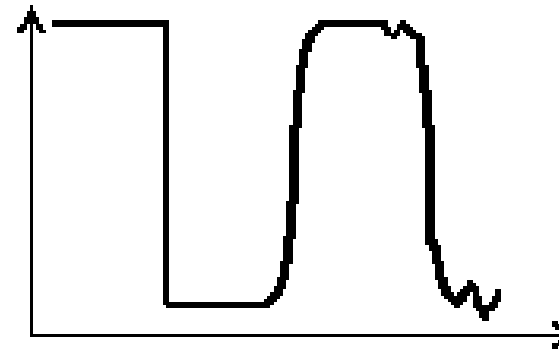
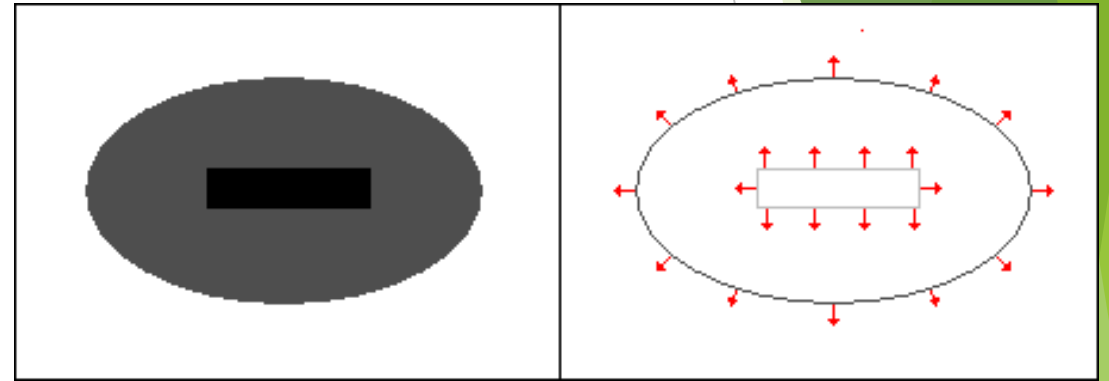


Edge Detection - Topics

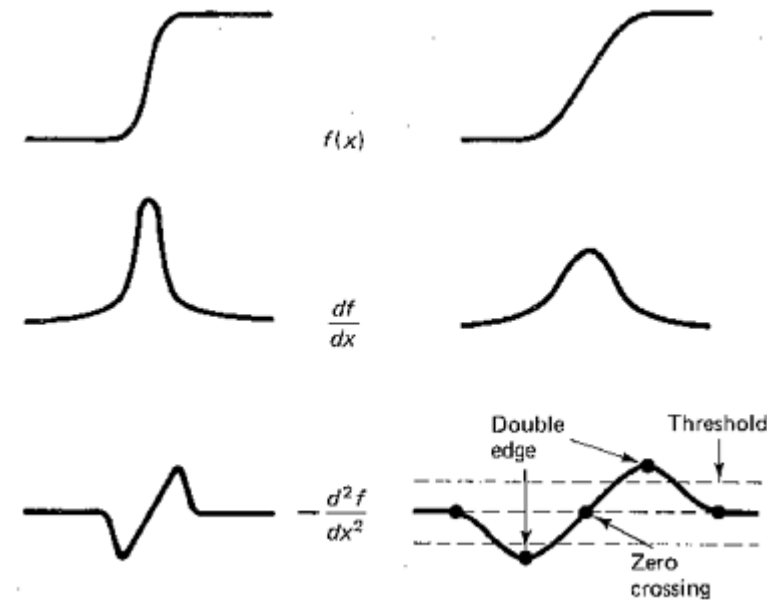
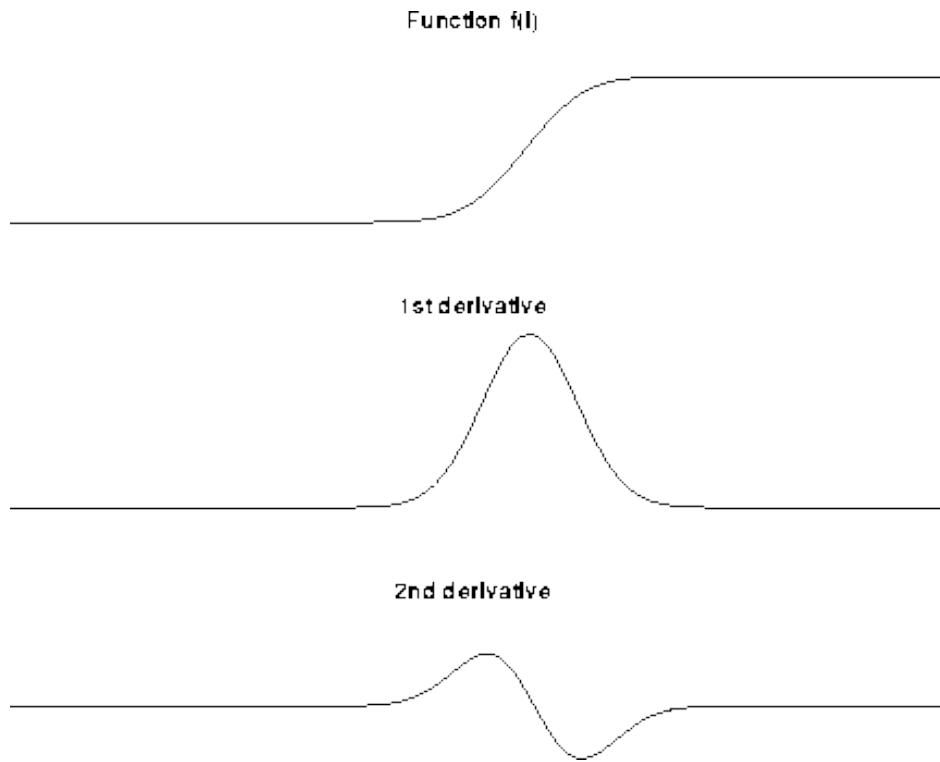
- ▶ 1st derivative edge detection - Sobel
- ▶ 2nd derivative edge detection - Canny
- ▶ Overview of Multispectral edge detection
- ▶ Application: Image sharpening

Edge Detection - What is an edge?

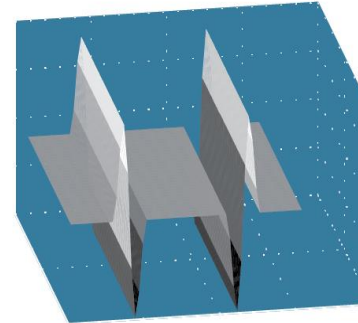
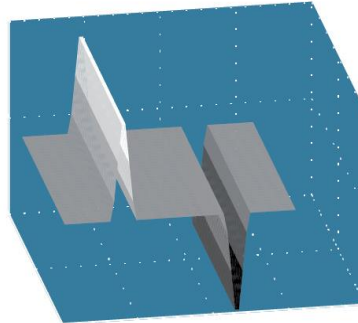
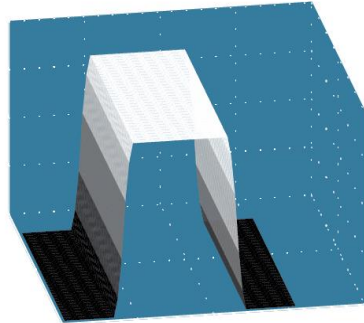
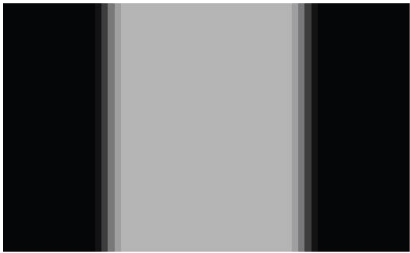
- ▶ Where brightness changes abruptly
- ▶ Edges have
 - ▶ Magnitude (Gradient)
 - ▶ Direction (Orientation)
- ▶ Edge Profiles
 - ▶ Step
 - ▶ Real
 - ▶ Noisy



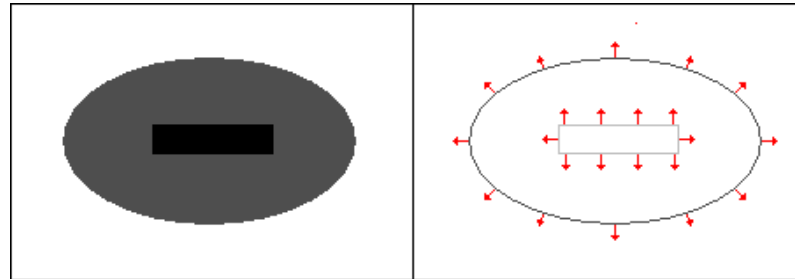
Edge Detection - derivatives



Edge Detection - 1st derivative definitions



- Recall: Vector variable -
 - Gradient Magnitude
 - Orientation (0 degrees is East)



Edge detection - 1st derivative - Sobel

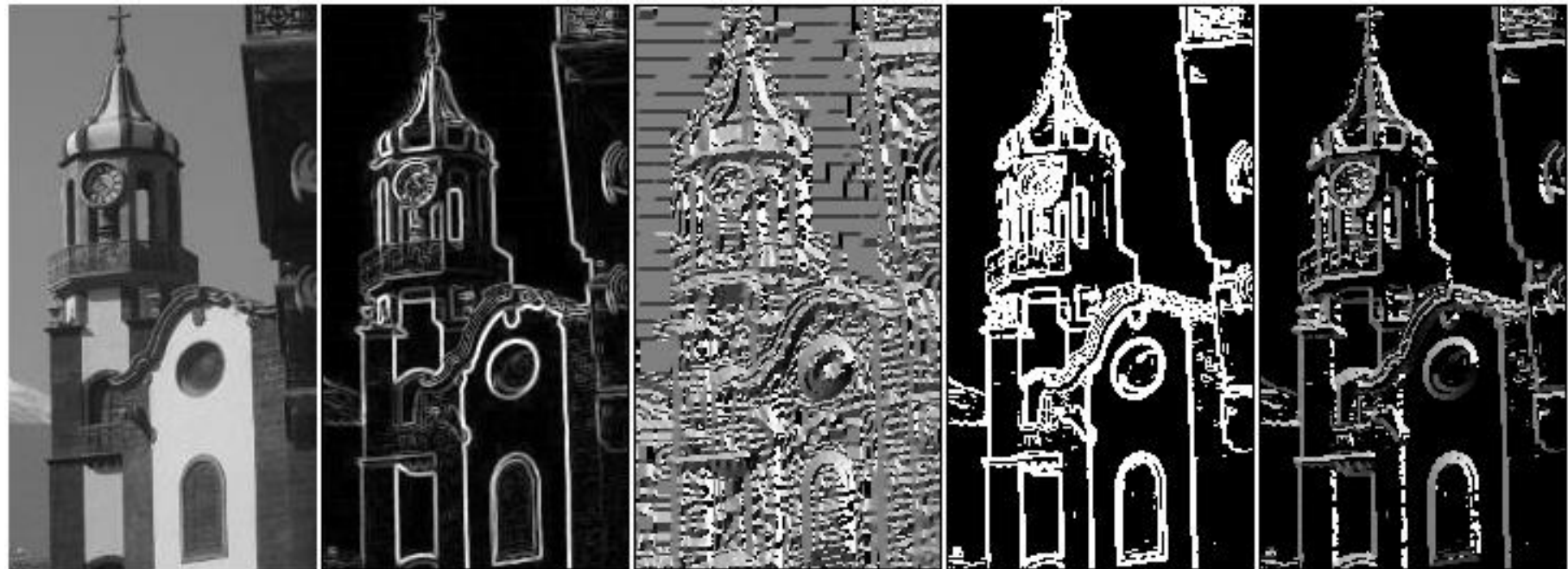
- ▶ The Sobel operator is used to find the approximate absolute gradient magnitude at each point in an input gray-scale image.
- ▶ Sobel detection uses these two below 3*3 convolution kernels to find edge in an image.

-1	0	1
-2	0	2
-1	0	1

G_x

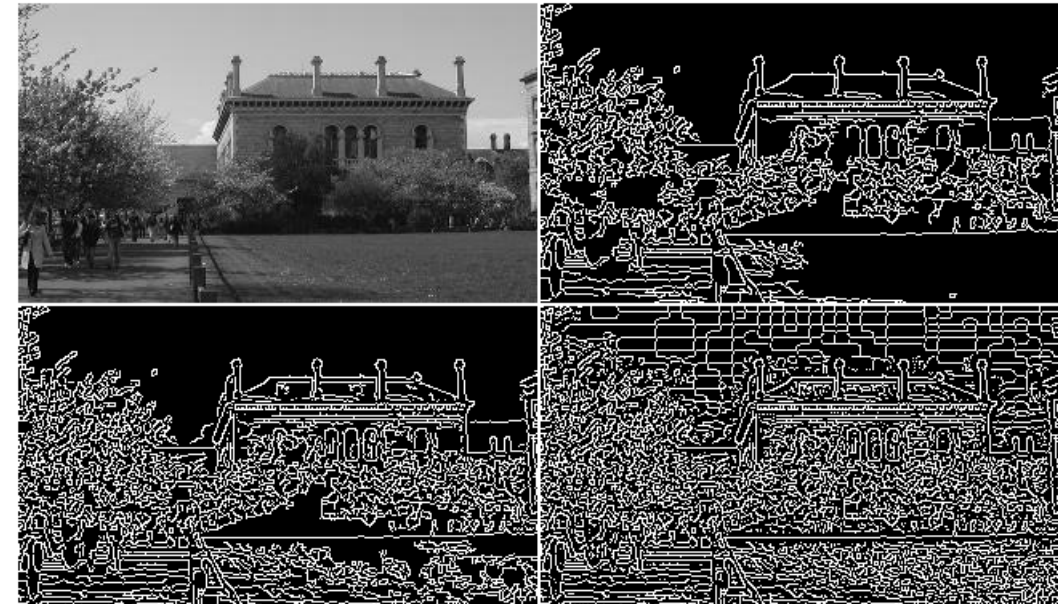
-1	-2	-1
0	0	0
1	2	1

G_y



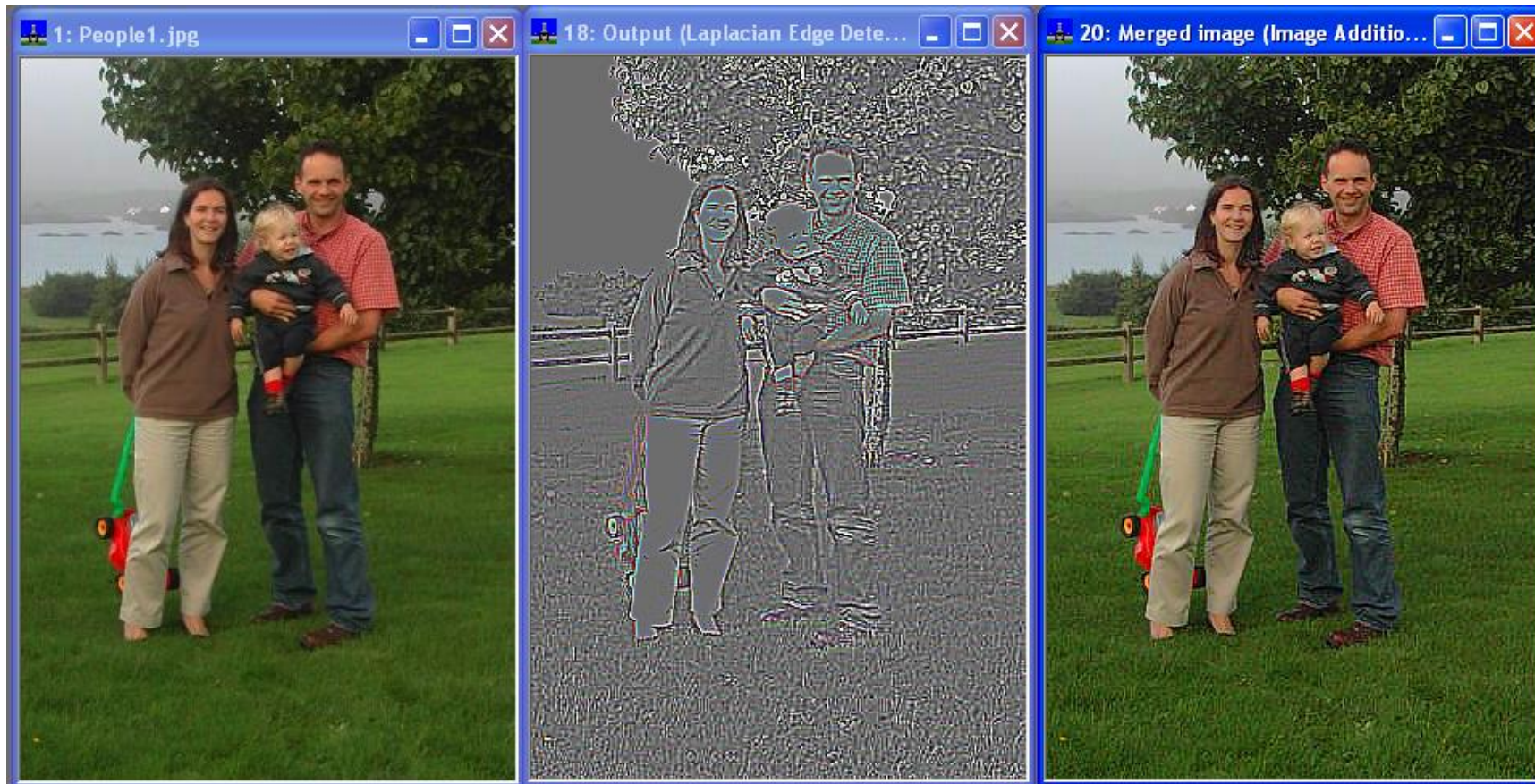
Edge detection - 2nd derivative - Canny algorithm

- ▶ Canny edge detection improved upon Sobel edge detection by:
 - ▶ Removing speckle noise with a low pass Gaussian filter first
 - ▶ Then applying a Sobel filter to detect edges
 - ▶ Then doing non-maximum suppression to pick out the best pixel for edges when there are multiple possibilities in a local neighborhood.
 - ▶ Offers more refined edges than Sobel
- ▶ Both can only function with grey-scale images



Application: Image sharpening

- Making edges steeper.



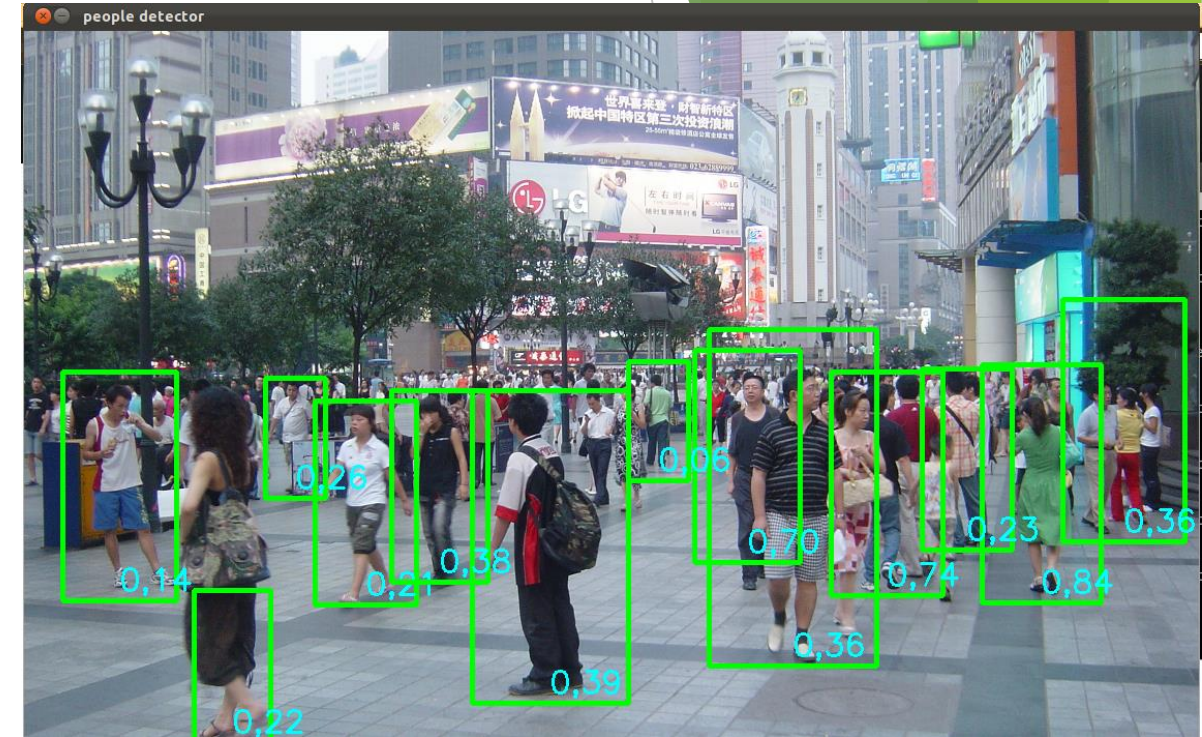
Application: Image sharpening

- Subtract a multiple (e.g. 0.3) of the Laplacian from the image.



OpenCV

- ▶ Open Source Computer Vision is a library of programming functions mainly aimed at real-time computer vision.
- ▶ Originally developed by Intel
- ▶ OpenCV is released under a BSD license - free for commercial use.
- ▶ Has C++, C, Python and Java interfaces and supports Windows, Linux, Mac OS, iOS and Android.
- ▶ Designed for computational efficiency. Written in optimized C/C++, the library can take advantage of multi-core/GPU processing.



Lab this week

- ▶ Intro to OpenCV
- ▶ Edge detection with Sobel and Canny