Image Segmentation

- After image enhancement and restoration, next step is segmentation of image
- Our aim is to understand the constituent parts of the image e.g. definition of vehicle and person present in the image.
- How?? There are different mechanism e.g. color based segmentations, texture based segmentation

Image segmentation

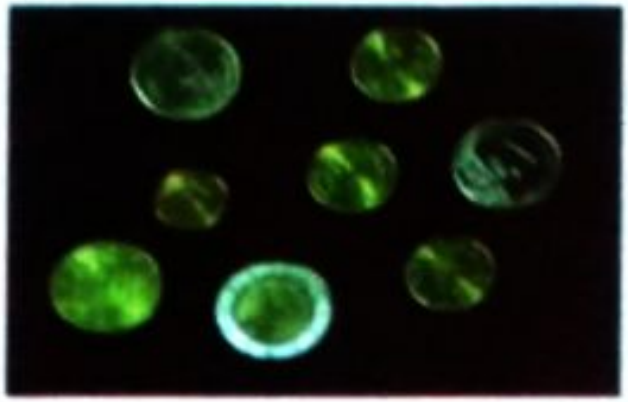
- The purpose of image segmentation is to partition an image into meaningful regions with respect to a particular application
- The segmentation is based on computations performed on the image and might be
  - grey level
  - Color: e.g. identification of grass based on green color, identification of roads based on dark gray color etc
  - Texture: usually in cloths there are textures. It's a combination of texons i.e. repeated patterns
  - Depth
  - Motion
- Image processing application has three steps:
  1. Preprocessing
  2. Feature extraction (segmentation is first step of the feature extraction)
  3. Classification

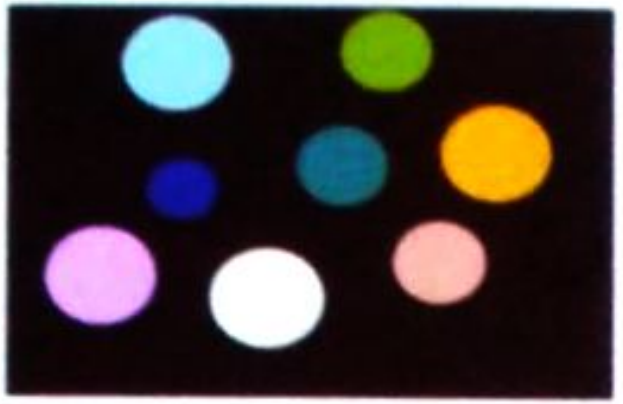
Image segmentation

- Usually image segmentation is an initial and vital step in a series of processes aimed at overall image understanding.
- Applications of image segmentation include
  - Identifying objects in a scene for object-based measurements such as size and shape
  - Identifying objects in a moving scene for object-based video compression (MPEG4)
  - Identifying objects which are at different distances from a sensor using depth measurements from a laser range and enabling path planning for a mobile robots. This can be calculated using depth or motion.

Image Segmentation

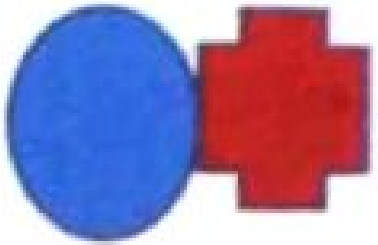
- Segmentation is first step of object recognition but not the object recognition
- Segmentation attempts to partition the pixels of an image into groups that strongly correlate with the objects in an image.
- Typically the first step in any automated computer vision application





Edge Detection

- Image segmentation can be done using three scenarios
  - Points
  - Line
  - Edges



- Edges: An Edge is a set of connected pixels that lie on the boundary between the two regions

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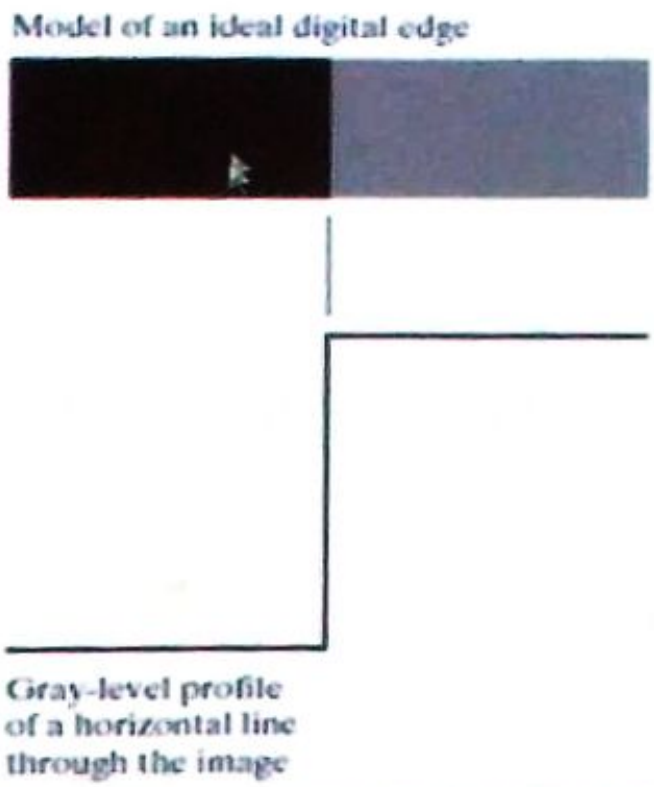
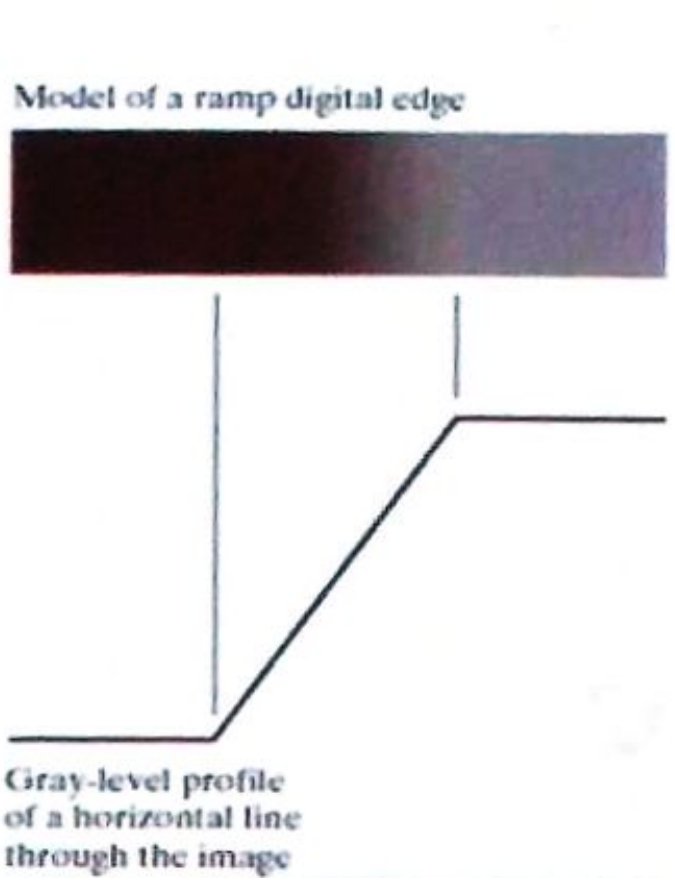
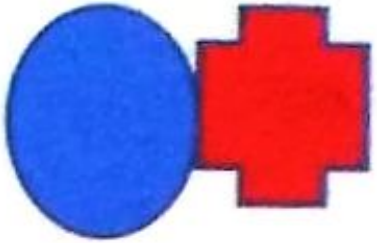
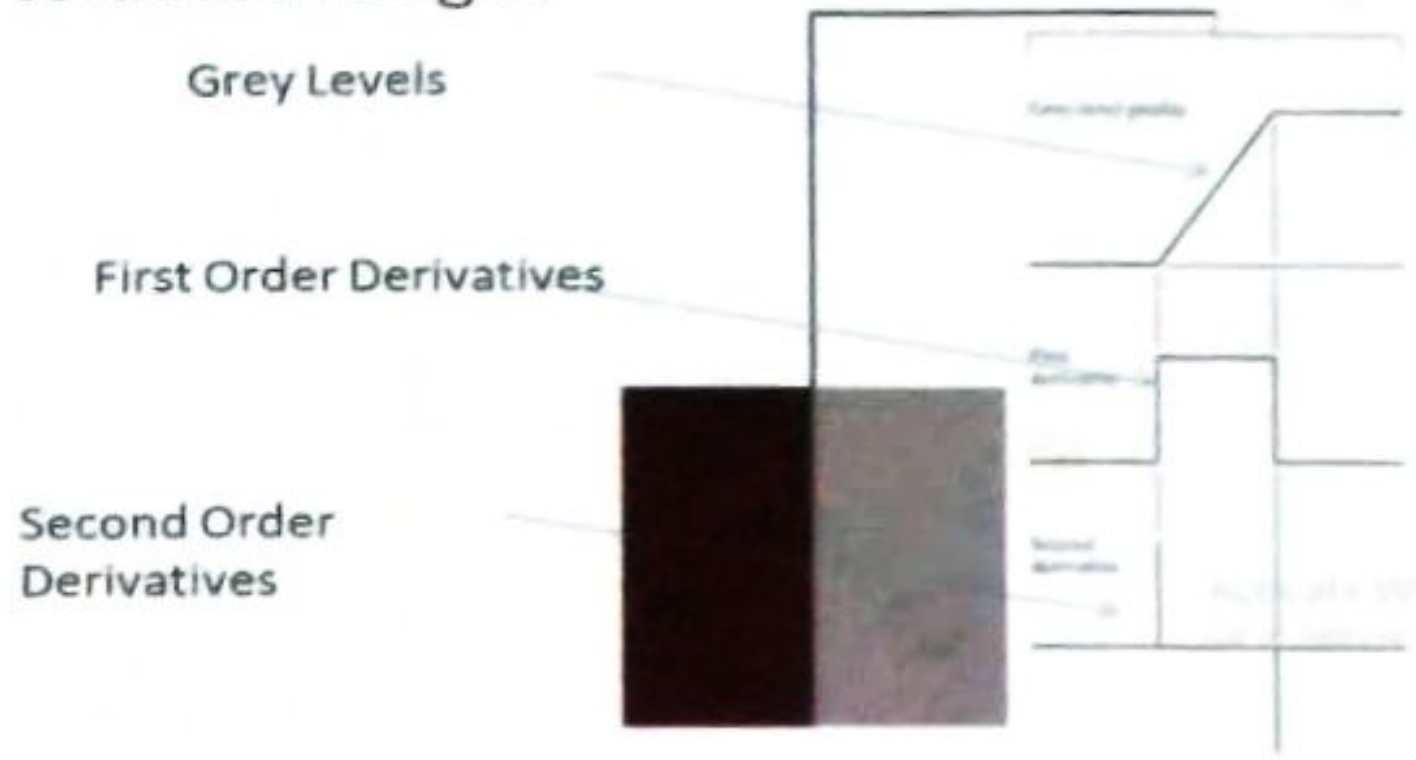






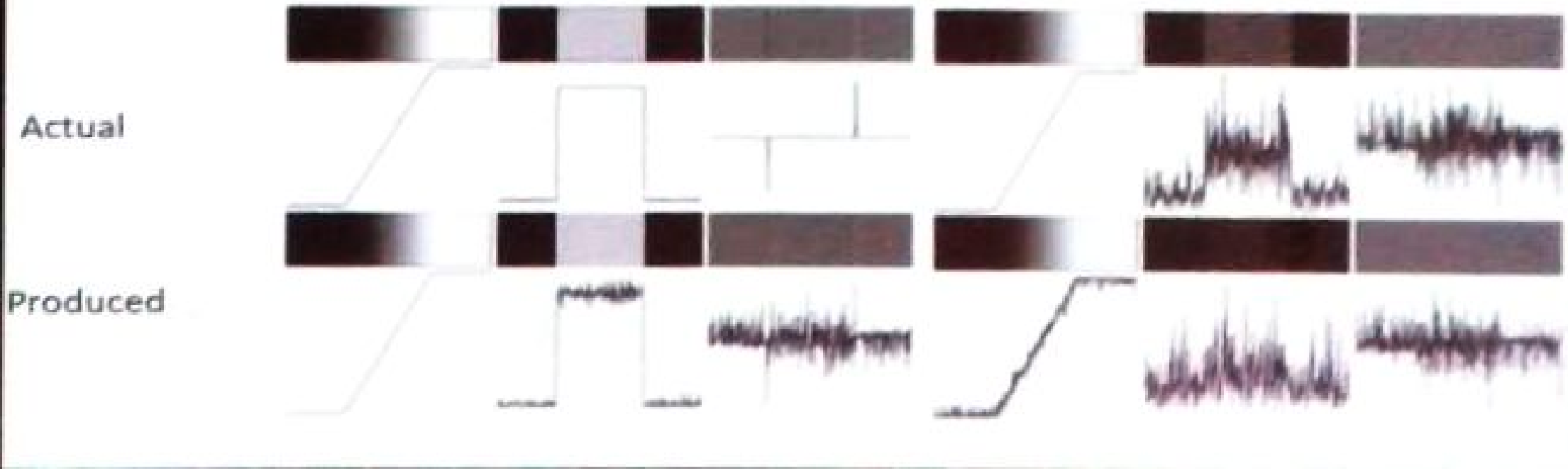
Edges and Derivatives

- Derivatives are used to find discontinuities
  - 1st derivative tells us where an edge
  - 2nd derivative can be used to show edge direction (either from black to white OR white to black)
  - We use both to detect edges



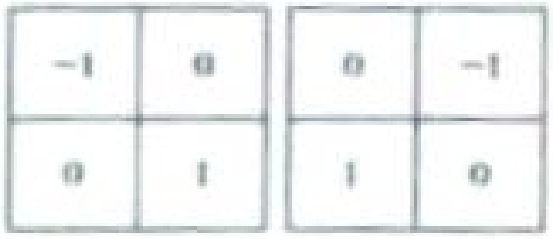
Derivatives and Noise

- Derivatives based edge detection methods are sensitive to the noise
- Usually derivative based operations are noisy operations
- Therefore we need to apply filter to remove such noise



Common Edge Detector Filters

- The following edge detection filters can be used



−1	0
0	1

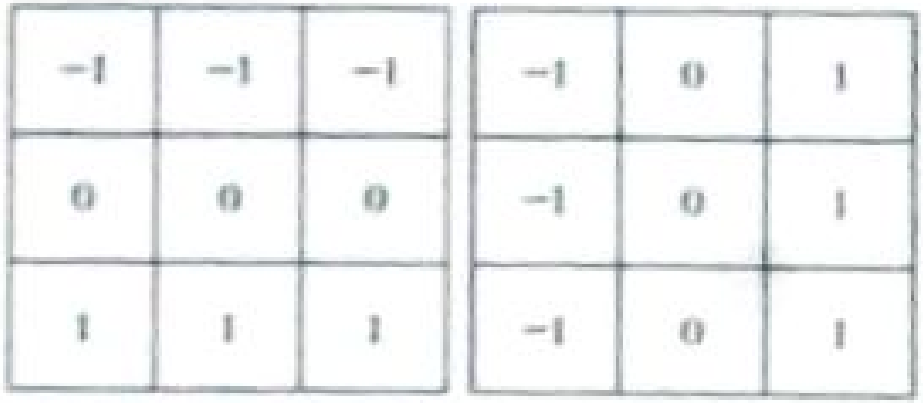
0	−1
1	0

Roberts

−1	−2	−1
0	0	0
1	2	1

−1	0	1
−2	0	2
−1	0	1

Sobel V Sobel H



−1	−1	−1
0	0	0
1	1	1

−1	0	1
−1	0	1
−1	0	1

Prewitt H Prewitt V

Edge Detection Example

Robert

Prewitt

Sobel

Detection of Discontinuities

- There are three basic types of grey level discontinuities which we are interested in digital images
  - Points
  - Lines
  - Edges
- We typically find discontinuities using masks and correlation

Points Detection

- Point detection can be achieved simply using the mask below:

−1	−1	−1
−1	8	−1
−1	−1	−1

- This mask gives high weight to the center pixel and nullify the neighboring pixels. That means will find the points in the image

Point Detection Example

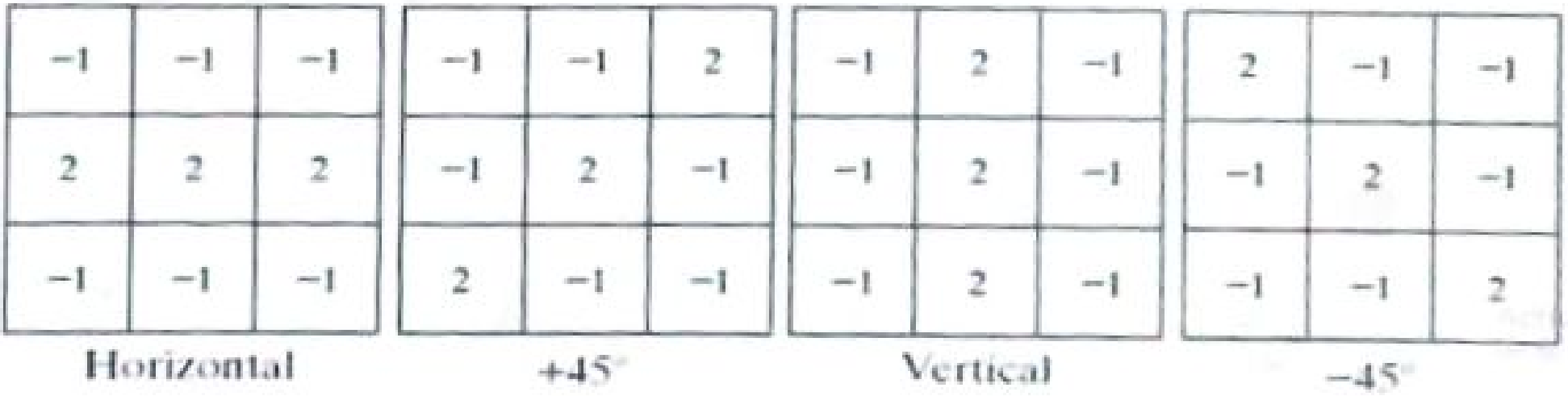
X-ray image of a turbine blade

Result of point detection

Result of thresholding

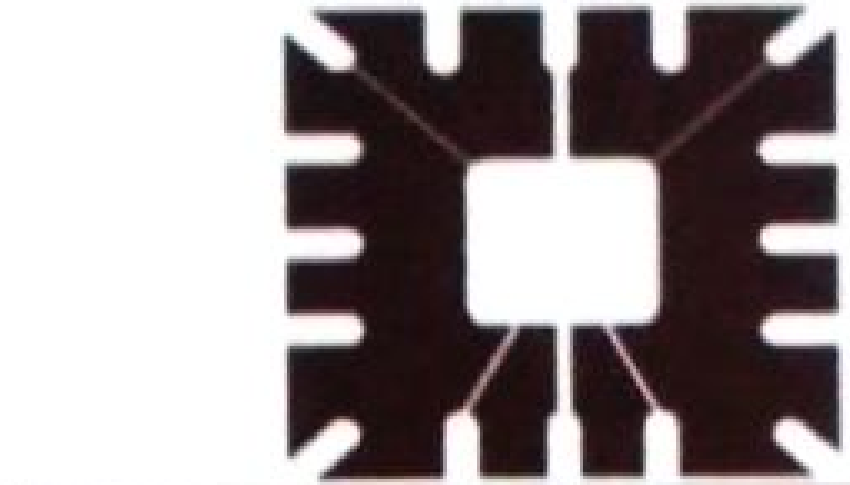
Line Detection

- The next level of complexity is to detect lines
- The masks given below extract lines that are **one pixel thick** and running in a particular direction



Line Detection-Example

Binary image of a wire bond mask



After processing with -45° line detector

Result of thresholding filtering result