

Edge-based Image Segmentation

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Edge-based Image Segmentation 基于边缘检测的图像分割

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CVBIOUC

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What?

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Edge & Boundary

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Edge & Boundary



The edge of object may be not a boundary, the boundary may also be not edge.



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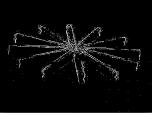
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Edge Tracking Curve Fitting Hough Transform Edge detection is a simple and fast technique used in segmentation methods. However, there also are some problems:

- Noise and background affect the accurate of edge detection.
- Edges are the sign of lack of continuity, and ending.







Steps in Edge Detection

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- **1** Filtering: Filtering to reduce noise results in a loss of edge strength.
- **2** Enhancement: In order to facilitate the detection of edges, it is essential to determine changes in intensity in the neighborhood of a point.
- 3 Detection: Find the zero crossing and peak value to detect edge.



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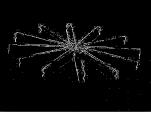
Linking

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Step in Image Segmentation

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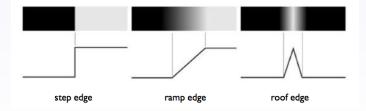
Edge Detection

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Edge Detection

Three edge types and definitions:

- Step edge
- Ramp edge
- Roof edge





Edge Detection

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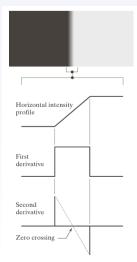
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Edge Detection Techniques¹

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- Roberts Edge Detection
- Sobel Edge Detection
- Prewitt Edge Detection
- Kirsch Edge Detection
- Marr-Hildreth Edge Detection (LoG)
- Canny Edge Detection

 $^{^1\}mathrm{Muthukrishnan.R}$ et~al., "Edge Detection Techniques For Image Segmentation", IJCSIT, 2011.



Edge Detection Techniques

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■ Roberts Edge Detection

-1	0
0	+1

0	-1
+1	0

■ Sobel Edge Detection

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

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

■ Prewitt Edge Detection

-1	-1	-1
0	0	0
+1	+1	+1

-1	0	+1
-1	0	+1
-1	0	+1



Marr-Hildreth Edge Detection (LoG)

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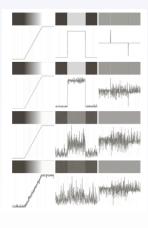
Curve Fitting

Hough

This method combines Gaussian filtering with the Laplacian for edge detection.

How does it work?

- The edge points of an image can be detection by second derivation.
- However, the second derivation is very sensitive to noise. A Gaussian filer is used to swipe away noise from the image.





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Edge Tracking Curve Fitting Hough Canny is the best edge detection detector.

Three basic objectives:

- Low error rate
- Edge points should be well localized



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Canny algorithm:

- Smooth image
- Compute gradient
- Non-maxima suppression
- Double thresholding











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Non-maxima suppression (NMS)

- Problem: Edges generated using gradient typically contain wide ridges around local maxima.
- Use non-maxima suppression to thin those ridges to find thin edges corresponding to local maxima.







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Double thresholding

Problem: The received image may still contain false edge points.







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- Dynamic Programming

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Each point is linked to the adjacent if magnitude and direction of the gradient are similar.

e(x,y) is magnitude of the gradient, $\phi(x,y)$ is the direction of the gradient, if two each points meet the following conditions:

$$\begin{cases} | e(x_i, y_i) - e(x_j, y_j) | \leq E \\ | \phi(x_i, y_i) - \phi(x_j, y_j) | \leq A \\ | e(x_i, y_i) |, | e(x_j, y_j) | > E \end{cases}$$



Curve Fitting

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Edge Linking Edge Tracking Curve Fitting Starting from a set of edge points, segments of a polygonal line are iteratively added until all the points are close enough to a segment.





Polygon Fitting

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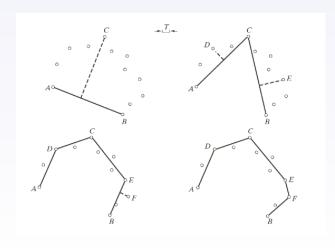
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Hough Transform

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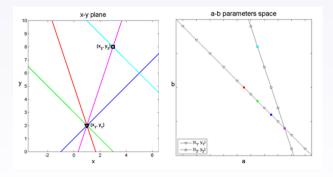
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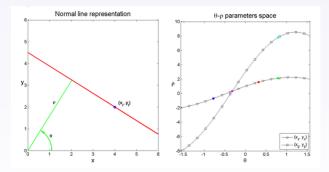
Hough Transform Find the most probable lines.





Hough Transform

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