Module 8 : Robot vision II

Lecture 30 : Image Segmentation(based on discontinuity and similarity) & region based segmentation

Objectives

In this course you will learn the following

- **Segmentation**
- Problem with vertical edges
- Global Edge Detection
- Region-oriented Segmentation

Segmentation

Sub-division of image into constituent parts Two approaches

- Based on discontinuity : G(x,y) and L(x,y)
- Based on similarity : Sobel Mask, Laplacian – identify edges

$$G(p) = \sqrt{G_x^2 + G_y^2} \approx |G_x| + |G_y| > T$$

a) Edge Linking

Orientation measure,

$$\theta = \tan^{-1}\left\{\frac{G_y}{G_x}\right\}$$

$$G(x_1, y_1) - G(x_2, y_2) < \Delta$$

$$|\theta_1 - \theta_2| < \delta$$

For bright objects: note the order of pixels

(...)(+ -) (0 or -) (- +) (...)

$$S(x,y) = \begin{cases} 0 & \text{if } G < T \\ + & \text{if } G >= T \text{ and } L > 0 \\ - & \text{if } G >= T \text{ and } L < 0 \end{cases}$$

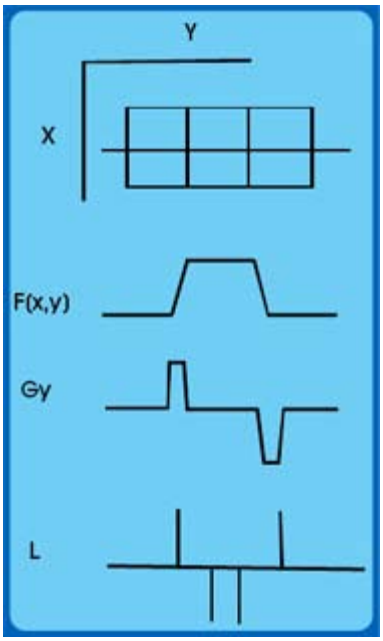

Figure 30.1 Segmentation

Finding straight lines (amongst edge pixels)

$(x_1, y_1) \ldots (x_N, y_N)$

$\delta(n^2) = n(n-1)/2$ combinations => a and b intercept (slope of line defined by (x_i, y_i) and (x_j, y_j))

$O(n^3)$ -> order of comparison required.

Instead use *Hough transform.*

Contd...

$y = ax + b$

Point (x_i, y_i)

$\Rightarrow b = (-x_i)a + y_i$

A point in (x_i, y_i) plane

=> a line in (a-b) plane

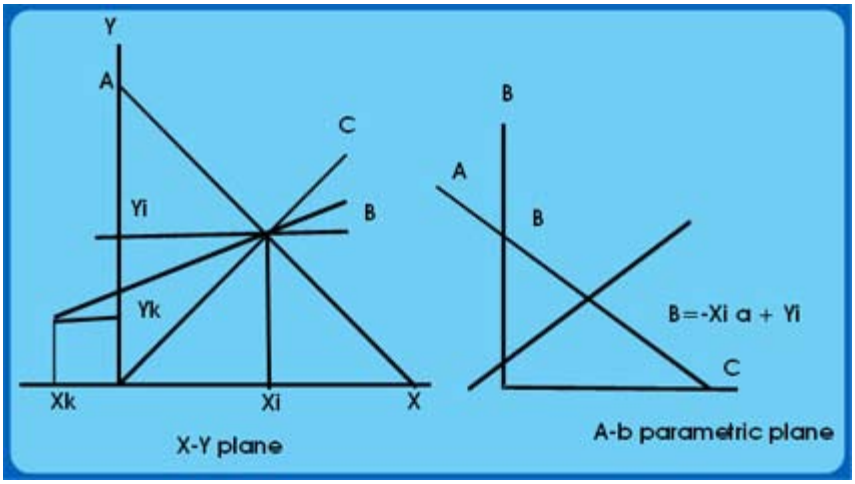

Figure 30.2 XY and Parametric Plane

The reverse is also true!

Problem with vertical edges

$r = x\cos\theta + y\sin\theta$

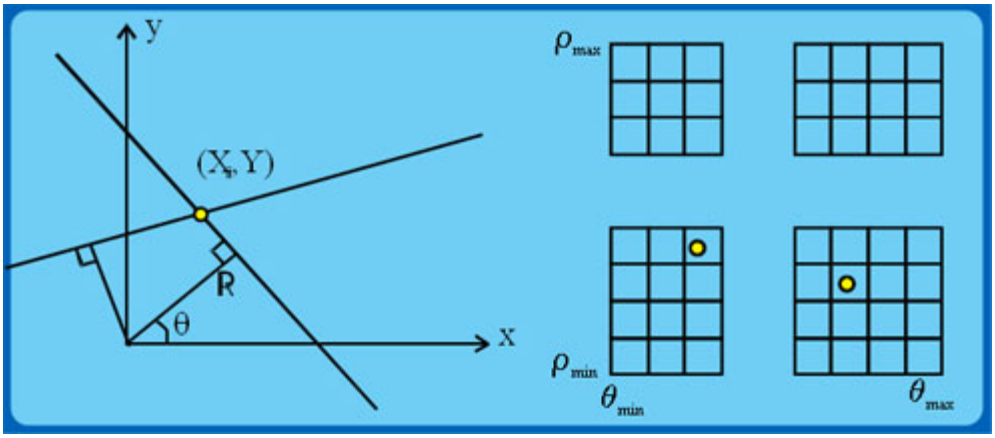

Figure 30.3 Problem with Vertical Edges

Region-oriented Segmentation

$$\bigcup_{i=1}^{N} R_i = R$$

$$(R_i \bigcap R_j) = \phi$$

$$P(R_i) = true$$

$$P(R_i \bigcup R_j) = false$$

R_i is connected

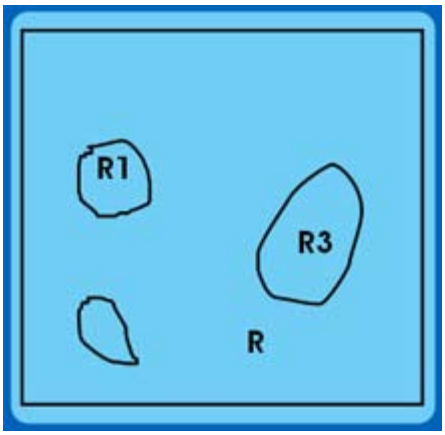

Figure 30.6 Region Oriented Segmentation

Global Edge Detection

H – Max difference between intensity values between object pixel and background pixel.

f(p) & f(q): Intensities at p and q respectively. Start at a node (Start node) End up at terminal node (end node)

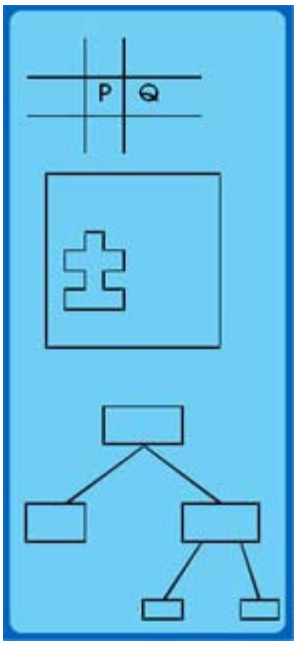

Figure 30.4 Global Edge Detection

Based on Similarities

1. Thresholding

$T = T(f(x,y))$ Global Threshold

$T = T(p(x,y), f(x,y))$ Local Threshold

$T = T(x,y,p(x,y), f(x,y))$ Dynamic Threshold

Choose thresh-hold, T such that

$P_1 p_1(T) = P_2 p_2(T)$

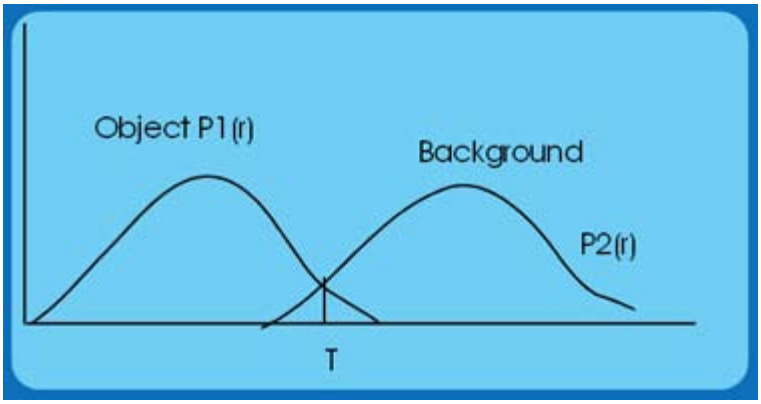

Figure 30.5 Thresholding

Region-oriented Segmentation

Quad Tree

Region Growing scheme

Region Splitting (and Merging)

$P(R) = false$

$P(R_1) = false = P(R_3) = P(R_4)$

$P(R_2) = true$

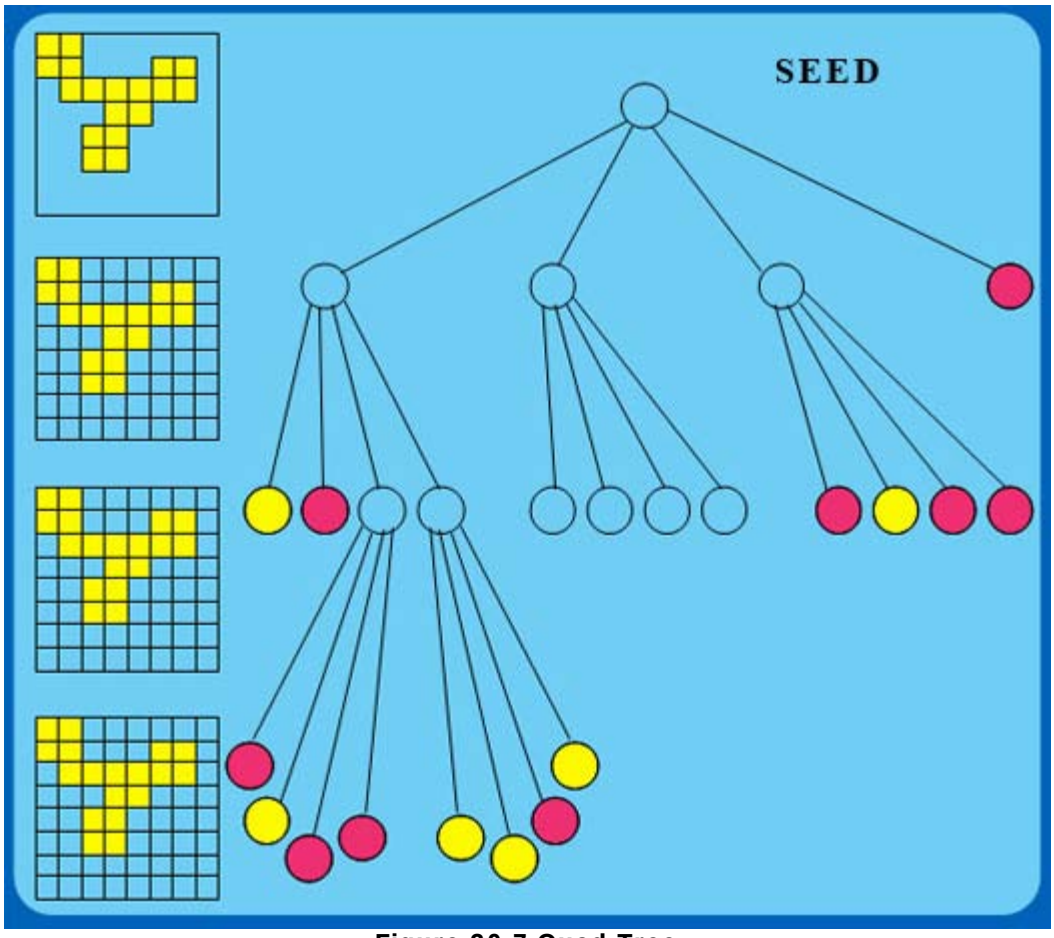

Figure 30.7 Quad Tree

Recap

In this course you have learnt the following

- **Segmentation**
- Problem with vertical edges
- Global Edge Detection
- Region-oriented Segmentation

Congratulations, you have finished Lecture 30. To view the next lecture select it from the left hand side menu of the page.