Chapter 3 Regions

Region; group of connected pixels with similar properties
correspond to objects - image partitioning

3.1 Regions and Edges

gray level image -> image attribute using partition

two approaches;
region based segmentation
boundary estimation using edge detection

Region based segmentation;
all pixels corresponding to an object are grouped together and marked as one region
criterion; value similarity, spatial proximity
good to ideal case, but not satisfied in many situations

Boundary estimation using edge detection
pixels on region boundary; edges
algorithm ; based on intensity characteristics, texture, motion

3.2 Region segmentation

image I
homogenity predicate; P(.)

$$\bigcup_{i}^{n} R_i = I$$

$$P(R_i) = True$$

$$P(R_i \cup R_j) = False$$

algorithm robust to variations in the scene ; knowledge

3.2.1 Automatic Thresholding

knowledge; intensity characteristics of objects
size of objects
fractions of an image occupied by the objects
No. of differents of objects appearing in an image

n objects; $O_1, O_2, \cdots, O_n$ including background

gray values populations; $\pi_1, \pi_2, \cdots, \pi_n$ with probability distribution $p_1(z), \cdots, p_n(z)$

Assume; dark object on light background

P-Tile Method

p % of image area ; object

Mode Method

gray values; (μ_1, σ_1) (μ_2, σ_2)

ideal case; $\sigma_1 = \sigma_2 = 0$

peakiness, valleyness

Algorithm 3.1 Peakiness detection for appropriate threshold selection

(1) Find the two highest local maxima in the histogram
that are at some minimum distance apart
local maxima are at; g_i, g_j
(2) Find the lowest point gk in the histogram H between g_i , g_j
(3) Find the peakiness, defined as $\min(H(g_i), H(g_j))/H(g_k)$
(4) Use the combination (g_i, g_j, g_k) with highest peakiness
g_k is a good threshold

Iterative threshold selection

(1) select an initial estimate of the threshold, T. i.e. average intensity
(2) Partition image into R_1, R_2 using T
(3) calculate mean gray values μ_1 for R_1, μ_2 for R_2
(4) select a new threshold; $T=\frac{1}{2}(\mu_1+\mu_2)$
(5) repeat until mean values don't change

Adaptive Thresholding

several mXm subimages
T_{ij} for each subimage

Variable Thresholding

uneven illumination
background normalizing - find fitted plane

Double Thresholding

Algorithm 3.3 Double thresholding for region growing

(1) Select two T_1, T_2
(2) Partition the image into 3 part; R_1; ($<T_1$), R_2; ($T_1< \ <T_2$), R_3; ($>T_2$)
(3) for each pixels in R_2, if the neighbor is in R_1, then reassign the pixels to region R_1
(4) Repeat step 3 until no pixels are reassigned
(5) Reassign the left pixels in R_2 to R_3

3.2.2 Limitations of Histogram Methods

Histogram based region;
cannot applied to complex scene

3.3 Region Representation

(1) Array representation
- Region labeling
- Bitmap

not symbolic information represented

(2) Hierarchical representation

(2-1) Pyramids

for nXn image

n/2Xn/2 , n/4Xn/4 , ... 1X1 ; k reduced images

(2-2) Quad trees

three type nodes; white, black, gray

recursive splitting of an image

(3) Symbolic representation

Enclosing rectangle

Centroid

Moments

Euler Number