

SEGMENTATION

THRESHOLDING

Image segmentation is a fundamental process in many image, video, and computer vision applications. It is often used to partition an image into separate regions, which ideally correspond to different real-world objects. It is a critical step towards content analysis and image understanding. The gray levels of pixels belonging to the object are entirely different from the gray levels of the pixels belonging to the background, in many applications of image processing.

Thresholding becomes then a simple but effective tool to separate those foreground objects from the background. We can divide the pixels in the image into two major groups, according to their gray-level.

These gray-levels may serve as “detectors” to distinguish between background and objects is considering as foreground in the image. Select a gray-level between those two major gray-level groups, which will serve as a threshold to distinguish the two groups (objects and background). Image segmentation is performed by such as boundary detection or region dependent techniques. But the thresholding techniques are more perfect, simple and widely used.

Different binarization methods have been performed to evaluate for different types of data. The locally adaptive binarization method is used in gray scale images with low contrast, Variety of background intensity and presence of noise.

The goal of segmentation is to simplify or change the representation of an image into something that is more meaningful and easier to analyse.

More precisely image segmentation is the process of assigning a label to every pixel in an image such that pixel with the same label share certain visual characteristics.

Complete segmentation: set of disjoint regions uniquely corresponding with objects in the input image.

Cooperation with higher processing levels which use specific knowledge of the problem domain is necessary.

Partial segmentation: regions do not correspond directly with image objects.

Image is divided into separate regions that are homogeneous with respect to a chosen property such as brightness,color,reflexivity,texture etc.

THRESHOLDING

The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into binary image.

The main purpose of thresholding is to extract those pixels from some image which represents an object(either text, or other line image data such as graphs,maps) .

Though the information is binary the pixels represents a range of intensities.

Thus the objective of binarization is to mark pixels that belong to true foreground regions with a single intensity and background regions with different intensities.

Thresholding is the transformation of an input image f to an output (segmented).

Threshold technique can be expressed as:

$$T=T[x, y, p(x, y), f(x, y)]$$

Where T is the threshold value. x, y are the coordinates of the threshold value point. $p(x,y), f(x,y)$ are points the gray level image pixels. Threshold image $g(x,y)$ can be define:

$$g(x,y)=1 \text{ for } f(x,y)>T \text{ and } g(x,y)=0 \text{ for } f(x,y)\leq T$$

where T is the thresholding, $g(x,y)=1$ for image elements of objects and $g(x,y)=0$ for image elements of background.

If objects do not touch each other, and if their gray-levels are clearly distinct from background gray level, thresholding is suitable segmentation method.

Segmentation using variable thresholds in which the threshold value varies over the image as a function of local image characteristics.

Global Threshold

Global thresholding is used when the intensity sharing between the objects of foreground and background are very distinct, a single value of threshold can simply be used to separate both objects apart. In this type of thresholding, the value of threshold T depends on the property of the pixel and the gray level value of the image. Some of the common used global thresholding methods are Otsu method, entropy based thresholding, etc.

A global threshold is determined from the whole image f :

$$T=T(f)$$

Local thresholding

This method divides an image into several sub regions and then chooses different thresholds T_s for each subregion respectively. Some common used local threshold techniques are 2-D entropy-based thresholding histogram transformation, simple statistical thresholding.

Local thresholds are position dependent:

$$T=T(f,fc)$$

Where fc is that image part in which the threshold is determined. One option is to divide the image f into sub images fc and determine a threshold value independently in each sub-images, it can be interpolated from thresholds determined in neighbouring images. Each sub-images is then processed with respect to its local threshold.

Basic thresholding as defined has many modifications. One possibility is to segment an image into regions of pixels with gray-levels from a set D and into background otherwise.

$$g(i,j)=1 \text{ for } f(i,j) \in D$$

$$g(i,j)=0 \text{ otherwise.}$$

Thresholding algorithm

For a thresholding algorithm to be really effective, it should preserve logical and semantic content. There are two types of thresholding algorithm:

- Global thresholding algorithm.
- Local or adaptive thresholding algorithm.

In global thresholding, a single threshold for all the image pixels is used.

When the pixel values of the components and that of background are fairly consistent in their respective values over the entire image, global thresholding could be used.

In adaptive thresholding, different threshold values for different local areas are used.

Basic global Thresholding

Simplest of all thresholding techniques is to partition the image histogram by using a single global threshold T .

Segmentation is then accomplished by scanning the image pixel by pixel and labeling each pixel as object or background, depending on whether the gray level of that pixel is greater or less than the value of T .

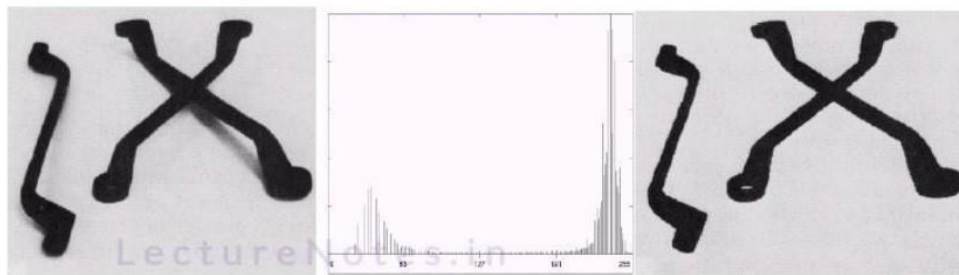


Fig 1(a)Original image (b)Image histogram (c)Result of global thresholding with T midway between the maximum and minimum gray levels

Here figure 1(a) shows a simple image and figure 1(b) shows its histogram, fig 1(c) shows the result of segmentation fig (1) by using a threshold value T midway between the maximum and minimum gray levels.

This threshold achieved a clean segmentation by eliminating the shadows and leaving only the objects themselves. The objects of interest in this case are darker than the background, so any pixel with a gray level $\leq T$ was labelled black(0) and any pixel with gray level $> T$ was labelled white(255).

The key objective is merely to generate a binary image, so the black-white relationship could be reversed.

Algorithm → Basic Global Thresholding

The following algorithm has been used to obtain the initial threshold value T , in the following section automatically.

step1= Choose initial estimate for T .

step2= Divide the histogram using T . This will produce 2 groups of pixels.

G1—> set of all pixels with grey values $> T$.

G2—> set of all pixels with grey values $\leq T$.

Step3= compute the average grey level values m_1 and m_2 for the pixels in region G1 and G2.

Step4= compute a new threshold value : $T = 1/2(m_1 + m_2)$.

Repeat step 2 to 4 until the difference in T in successive iteration is smaller than a predefined parameter T_0 .