

# Machine Vision- Homework 2

## Image segmentation

### Image Classification using a histogram-

The histograms are the type of bar plots which converts the data in the form of bins. After plotting the histogram we can even change its properties like for eg. Quickly modifying the properties of the bins and the display of the objects. Please find the various functions which are used to create histograms listed below-

`histogram(X)` – Displays the histogram for image X

`histogram(X,nbins)` – Displays the histogram with the specified no. of bins

`histogram(X,edges)` – Displays the histogram with specified no. of edges

`histogram('BinEdges',edges,'BinCounts',counts)` – manually specifies bin edges and bin counts

`histogram(C)` – plots an histogram with a bar for each category

`histogram(C,Categories)` – plots the mentioned categories only

`histogram('Categories',Categories,'BinCounts',counts)` – manually specifies categories and the associated bin counts

`histogram(____,Name,Value)` – specifies additional option with one or more names

`histogram(ax,____)` – plots axes specified by the ax parameter

`h = histogram(____)` – returns an histogram object, this is used to change the properties of the histogram and its display [6].

Each of the functions listed above can change the properties of the bins of the histograms and hence change the display of the same.

### Image segmentation using Otsu's method-

Image segmentation is the process of segmenting the data set i.e. pixels of the image into two different classes so that the data belonging to different classes/segments can be easily identified and segregated. As a part of image segmentation, the data is first converted into the Gray scale and then the Gray scaled image is thereafter converted to a binary image which is being classified on the basis of the threshold value.

The Otsu's method works well when the pixels belonging to a particular class are being placed close to each other so that a cluster can be formed out of them and different clusters can be segregated then. Otsu method is a clustering-based image thresholding method. It works when the histogram is bimodal. The method basically tries to minimize the within class variance and at the same time it maximizes the between class variance.

Total variance = Within class variance + Between Class Variance.

So in turn it helps us in identifying the most appropriate location or threshold which can be used for image segmentation properly. The Otsu's method of image processing and segmentation named after its creator Nobuyuki Otsu which is the simplest method available for obtaining the threshold point for image segmentation which works based on optimizing a gray scaled image. [8]

Image -> Greyscale -> Histogram -> Otsu's Thresholding [1]

**Please note-** The Otsu's method works well only with bimodal histogram's where the data classification can be done very easily. However, if we try to apply the algorithm on any of the other kinds of histogram's where we don't have 2 modes or classifications shown then it is very difficult to identify the threshold value and the algorithm mostly fails to achieve the proper result in this case.

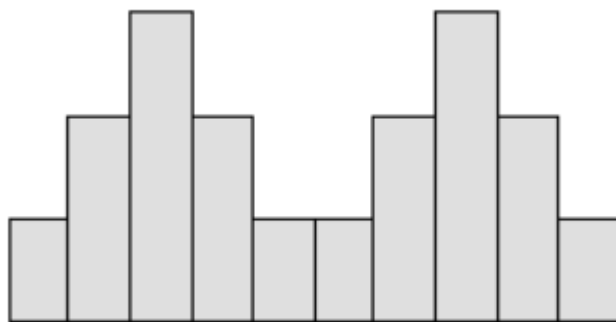


Figure 1 : Bimodal Histogram [8]

We have a number of functions which are used by Otsu's method for the purpose of segmentation for gray images and RGB images. Please find them listed below-

### **1. graythresh function-**

The graythresh function is an implementation of the Otsu's method which classifies the pixels present in a gray image and identifies the threshold value of the same. So, in order to convert the gray image into a binary image, we use imbinary function which converts the grayscale image into the binary image based on the best optimal threshold values available. [2] Please find the commands used for the same below-

```
I = imread ('test.png')
```

```
Level = graythresh (I)
```

```
BW = imbinarize (I, Level)
```

```
Imshowpair (I, BW, 'montage')
```

### **2. otsuthresh function-**

The otsuthresh function works in a similar way as the graythresh function and is used to obtain the optimal threshold value out of the present dataset which constitutes of the pixels belonging to the

different class segments. However, it tries to identify the count by plotting a histogram for the given image. [3]

```
I = imread ('test.png')
[count, x] = imhist (I, 16)
stem(x,counts)
T = otsuthresh (counts)
BW = imbinarize (I,T)
Figure
Imshow (BW )
```

**Please note-** The main difference between the graythresh and otsuthresh is that the graythresh function needs an image as an argument while the otsuthresh function needs a histogram instead as an input parameter. But if we will try to check the function definition for the graythresh function then we will see that the function itself converts the image into a histogram first with 256 as the bin value whereas the otsuthresh function uses 16 as the bin value. Please find the code for reference-

```
if ~isempty(I)
    % Convert all N-D arrays into a single column. Convert to uint8 for
    % fastest histogram computation.
    I = im2uint8(I(:));
    num_bins = 256;
    counts = imhist(I,num_bins);

    if nargin <= 1
        level = otsuthresh(counts);
    else
        [level,em] = otsuthresh(counts);
    end
else
    level = 0.0;
    em = 0;
end
```

So we can see here clearly that graythresh method is an implementation of the otsuthresh method .

### **3. multithresh function-**

The multithresh function is used to calculate or identify the threshold values in multiple planes or multiple level of images from a single image. It is mostly used for the RGB images where we need to do the segmentation on the basis of the colour of the image. One of the functions which is used to convert the single image into multiple images is **imquantize function** which are convert an image into multiple levels depending on the no. of threshold values generated by the function. [4]

## **Image segmentation using Triangle method-**

As stated above, the Otsu's method is used for the segmentation of data where we have a bimodal histogram. However, in case if we have weak peak figures then we can go for Triangle thresholding method which usually works by finding the corner of the skewed curve of the histogram, once the corner is identified then it draws a line from the topmost point i.e. the corner to the last or the bottom most point. Once the line is drawn, we start drawing perpendiculars to all the points of the line and try to measure the distance between the histogram and the perpendiculars. The level where the distance between the histogram and the perpendicular is maximum is called as the threshold value i.e. level.[5]

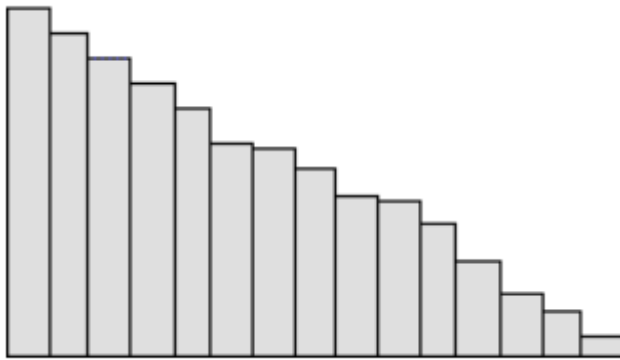


Figure 2 : Skewed Histogram [8]

## **References –**

1. Sunil L. Bangare, Amruta Dubal, Pallavi S. Bangare and Dr. S. T. Patil (2015) , “ Reviewing Otsu's Method For Image Thresholding ” , International Journal of Applied Engineering Research ISSN 0973-4562 Volume 10, Number 9 (2015) pp. 21777-21783
2. <https://www.mathworks.com/help/images/ref/graythresh.html>
3. <https://www.mathworks.com/help/images/ref/otsuthresh.html>
4. <https://www.mathworks.com/help/images/ref/multithresh.html>
5. <https://www.mathworks.com/matlabcentral/answers/375128-how-to-show-the-chosen-threshold-value-with-a-red-line-in-the-histogram-of-an-image>
6. <https://www.mathworks.com/help/matlab/ref/matlab.graphics.chart.primitive.histogram.html>
7. <https://www.mathworks.com/matlabcentral/fileexchange/51297-image-segmentation-using-otsu-method>
8. [https://www.pqsystems.com/qualityadvisor/DataAnalysisTools/interpretation/histogram\\_shape.php](https://www.pqsystems.com/qualityadvisor/DataAnalysisTools/interpretation/histogram_shape.php)