# Activity 5

## Enhancement by Histogram Manipulation

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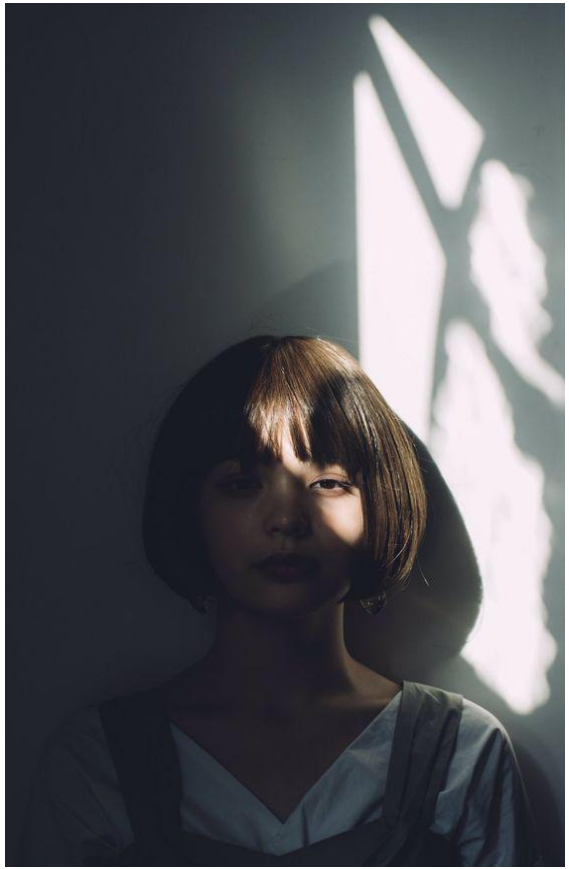

Figure 1. Original dark image to be enhanced

# Original image

To be done:

- contrast stretching
- histogram manipulation by backprojection

[1] https://pinterest.com. Accessed 25 Aug 2019.

# Contrast stretching

## Image result after contrast stretching

It can be observed that despite applying the contrast stretching method, there is no difference observed between the two photos. This is because the original image has:

Global min = 0
Global max = 255

Such technique will not work with these minimum and maximum values.


Figure 2. Original grayscale image (left) and its contrast-stretched counterpart (right)

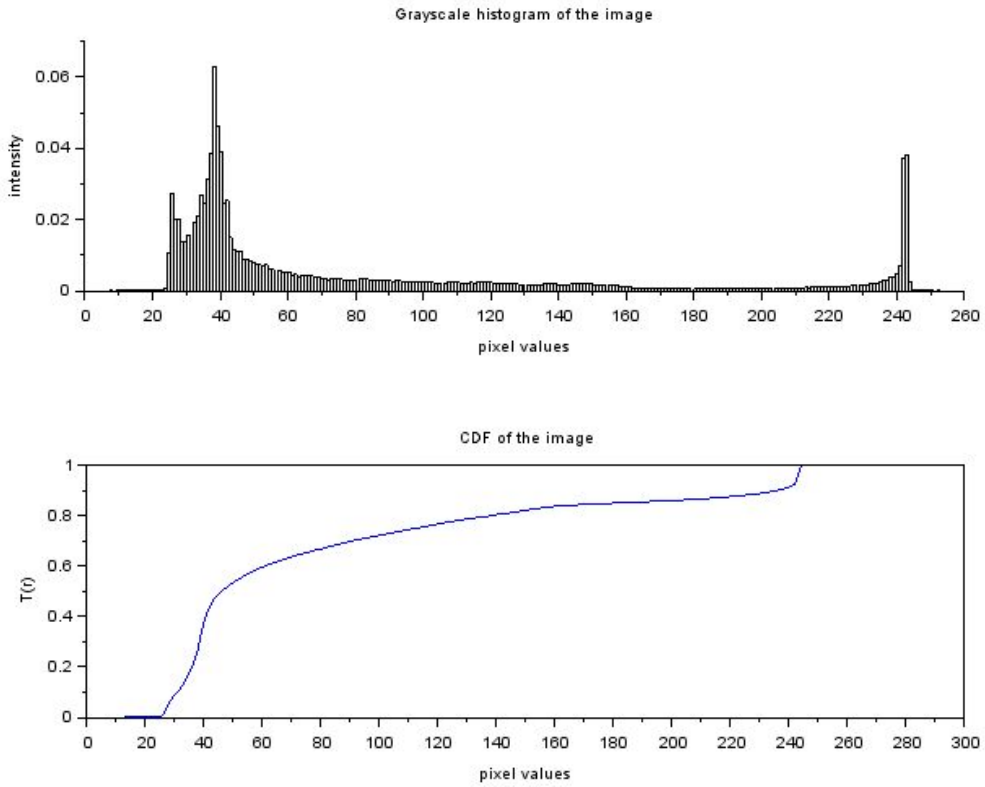


Figure 3. PDF (top) and CDF (bottom) of the original grayscale image

## PDF (NORMALIZED HISTOGRAM) AND THE CUMULATIVE DISTRIBUTION FUNCTION (CDF)

The lower pixel values on the x-axis of the plots are nearer to black while the higher values are nearer to white. From Figure 1, although the image is dark, whites are still prominent.

The PDF (Figure 3) shows that the image has prominent black and white colors. Black has the highest peak so the image is still mostly dark-colored.

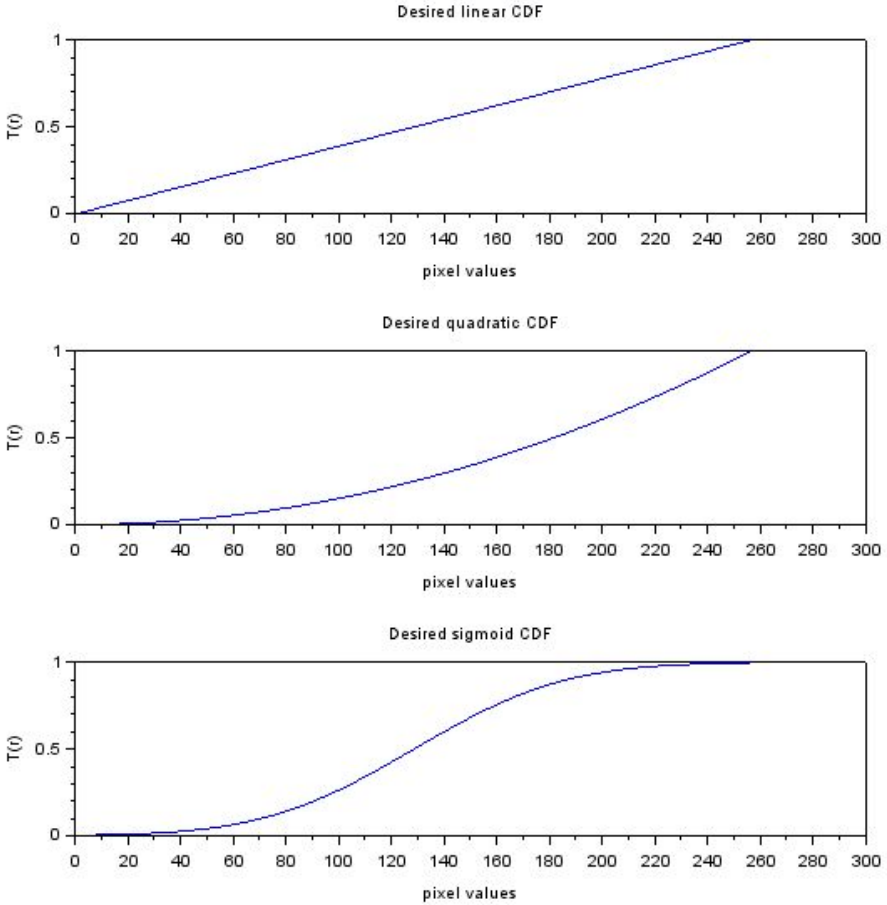


Figure 4. Desired CDFs using three curves-- linear (top), quadratic (middle), sigmoid (bottom)

## Desired cumulative distribution functions (CDF)

The linear CDF follows a straight line wherein the pixel values are distributed linearly from 0 to 255.

On the otherhand, the quadratic CDF is not as well-distributed over the pixel values as the linear CDF.

Lastly, a sigmoid function was used to observe another nonlinear curve. It can be seen from its plot the it is slightly more concentrated on the center.

We use these plots to compare the CDFs obtained after applying backprojection on a grayscale image later on.

# Histogram manipulation by backprojection

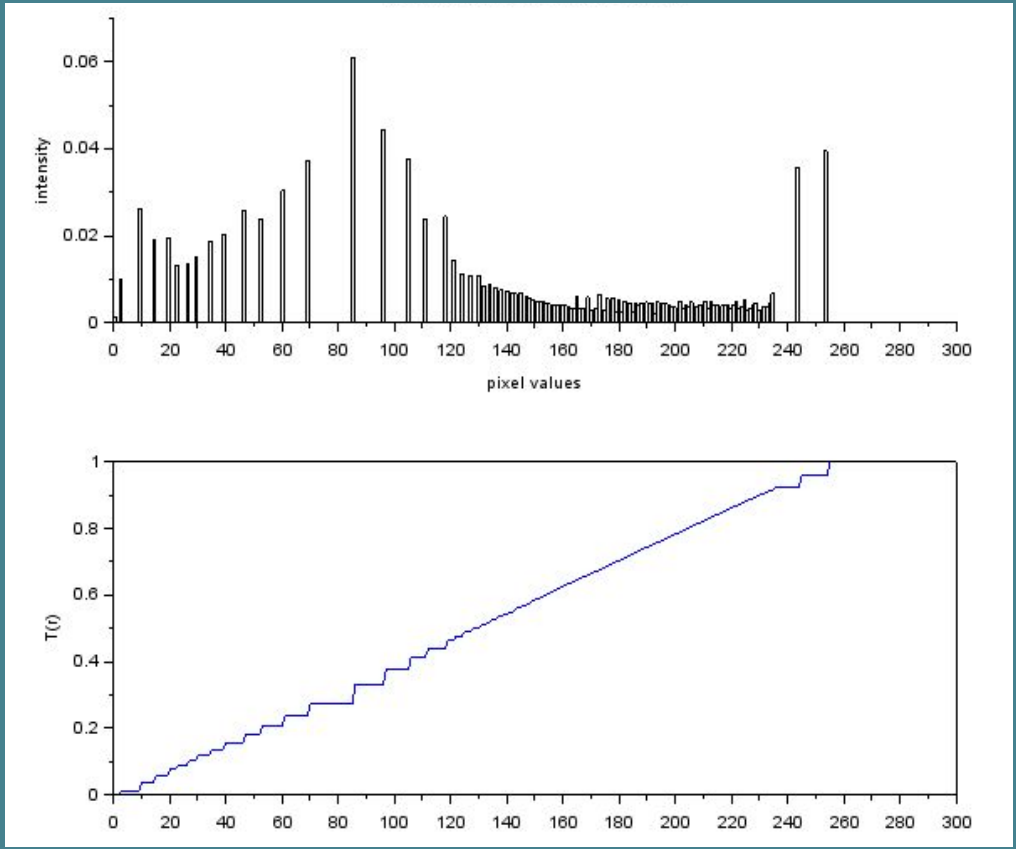


Figure 5. PDF (top) and CDF (bottom) of the linear backprojected image

## Linear cumulative distribution function (CDF)

Comparing to the original PDF, the PDF after manipulating the image using linear CDF showed a more spread normalized histogram.

This well-distributed characteristic can be seen more clearly on the obtained CDF as it is linearly distributed from pixel values 0 to 255.

The obtained linear CDF follows the desired linear CDF in Figure 4.

Figure 6. The original grayscale image (left) and the modified image through backprojection using linear CDF (right)

Since the linear CDF showed a linearly distributed plot from pixel values 0 to 255, the new image is expected to be excellently enhanced.

It can be seen on the modified image that the contrasts in the image is much more balanced. It showed tiny details that were not very noticeable on the original one.

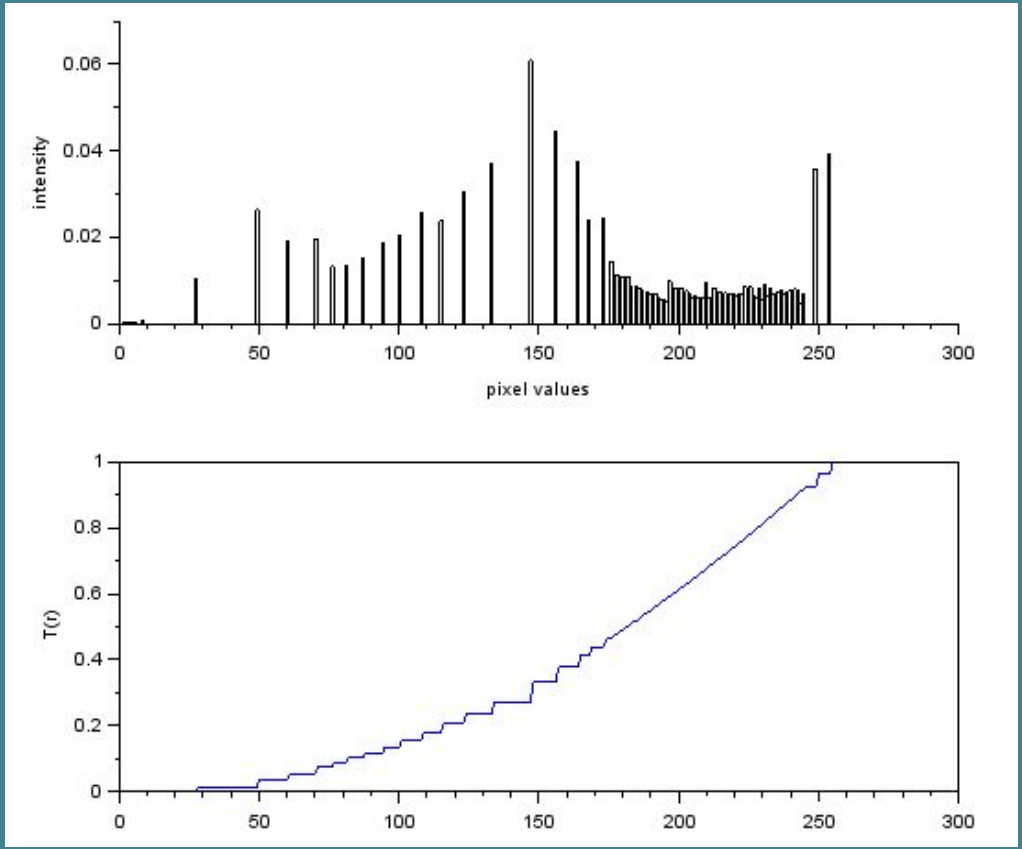


Figure 7. PDF (top) and CDF (bottom) of the quadratic backprojected image

## Quadratic cumulative distribution function (CDF)

The PDF is somewhat similar to the PDF obtained using linear CDF, except that in this one, the peaks are more headed to the right.

The CDF follows the contour of a parabola, thus follows the desired quadratic CDF in Figure 4.

Figure 8. The original grayscale image (left) and the modified image through backprojection using quadratic CDF (right)

The quadratic CDF brightened the image extently and this is because in the plot of the quadratic CDF, there is a slow increase on the lower pixel values (darker) and heightened on the higher pixel values (brighther).

This can also be explained from its PDF plot which is more headed to the right (brighter pixels).

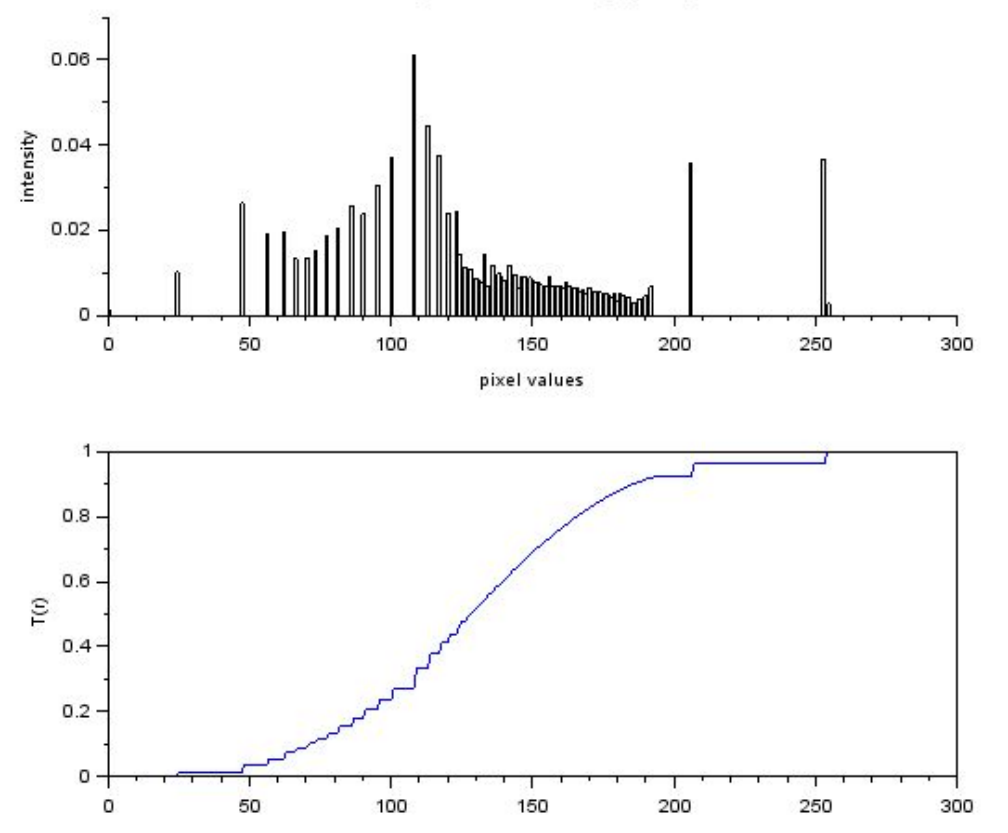


Figure 9. PDF (top) and CDF (bottom) of the sigmoid backprojected image

## Sigmoid cumulative distribution function (CDF)

As expected, the PDF is more concentrated on the center.

The CDF obtained using the erf() function follows the desired one shown in Figure 4.

Figure 10. The original grayscale image (left) and the modified image through backprojection using sigmoid CDF (right)

Since the CDF plot is much concentrated on the center, the new modified image has a prominent gray color.

It can also be observed that the new image has a glossy-like finish.

Original grayscale image

After backprojection using Linear CDF

After backprojection using Quadratic CDF

After backprojection using Sigmoid CDF

## Backprojected images using different curves

# SUMMARY

For me, the best technique in enhancing a dark image is the linear backprojection since it balances the blacks and whites in the image. I recommend using the quadratic CDF when handling really dark and heavily-contrasted images as it extensively brightens the image and reveals some details that are not seen or not noticeable on an unedited image. Using the sigmoid CDF for backprojection is also great in image manipulations, especially when you want your final image to be gray.

# Self evaluation

| | |
|---|---|
| Technical correctness | 5 |
| Quality of presentation | 5 |
| Initiative | 2 |
| **Total** | **12** |

Doing this activity was a lot of fun. At first it was quite frustrating because I am not really familiar with SciLab, but doing some research on some functions helped me get what I am aiming to. To be honest, until now, I still can’t figure my way out in SciLab without searching help on the internet. I wish we could have a crash course in Scilab, even for a single meeting. :>