Histogram Equalization

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1 Histogram equalization method

Histogram equalization is a technique used to enhance the contrast of an image by redistributing the intensity levels of the pixels. It aims to transform the image's histogram to achieve a more uniform distribution of pixel intensities. This process can be especially useful for improving the visual quality of images with poor contrast.

Algorithm

The histogram equalization algorithm involves the following steps:

1. Calculate the histogram of the input image.
2. Calculate the cumulative distribution function (CDF) of the histogram.
3. Normalize the CDF to ensure that it spans the entire intensity range.
4. Compute the mapping function that transforms each pixel's intensity value.
5. Apply the mapping function to every pixel in the image.

Mathematical Equations

- Let $H(i)$ represent the histogram of the input image, where i ranges from 0 to 255 (assuming 8-bit grayscale images). The cumulative distribution function (CDF) is defined as:

$$CDF(i) = \sum_{j=0}^{i} H(j)$$

- The normalized CDF is calculated by dividing the CDF by the total number of pixels in the image:

$$CDF_{\text{normalized}}(i) = \frac{CDF(i)}{\text{total number of pixels}}$$

- The mapping function $M(i)$ transforms the pixel intensity values based on the normalized CDF:

$$M(i) = \text{round}\left(255 \cdot CDF_{\text{normalized}}(i)\right)$$

- Finally, the equalized pixel intensity value $I_{\text{equalized}}$ is obtained by applying the mapping function to the original pixel intensity value I:

$$I_{\text{equalized}} = M(I)$$

1.1 Results

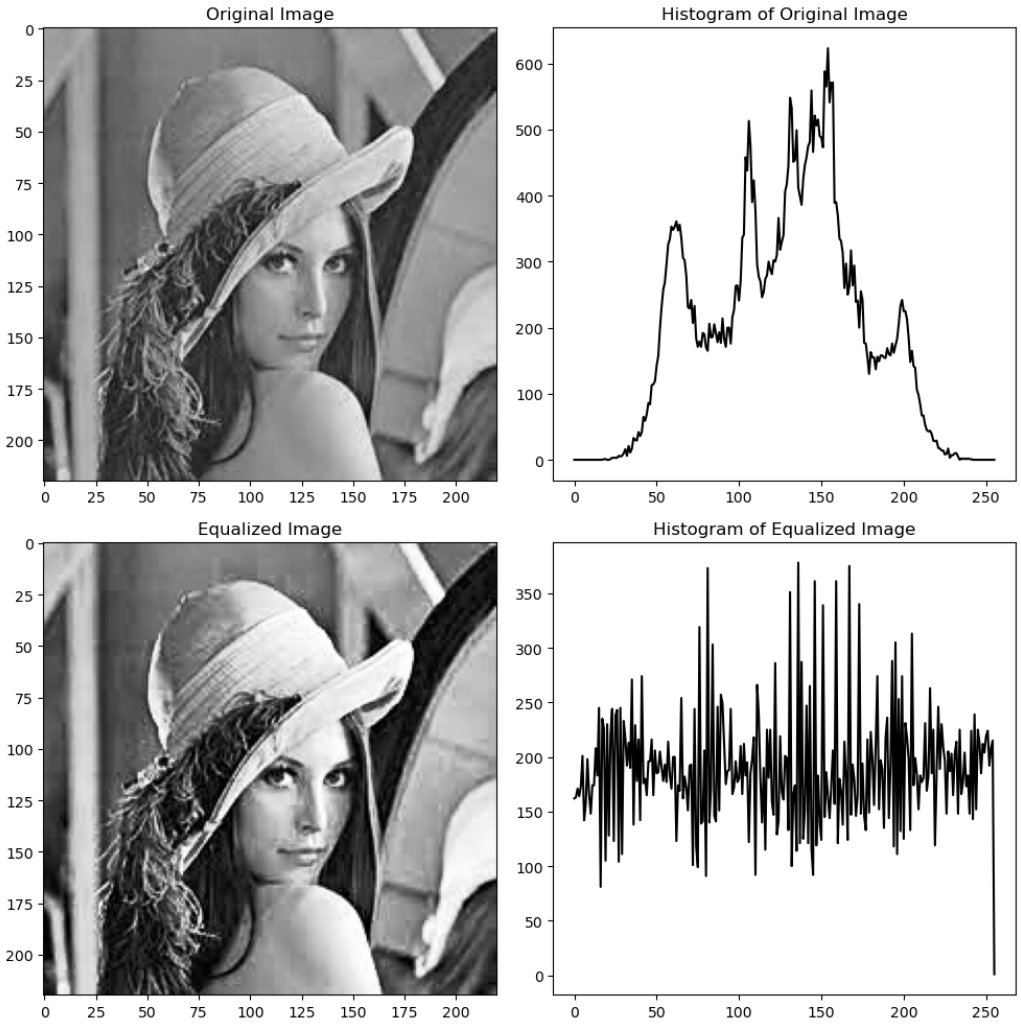

Figure 1: Bilinear Interpolation