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FIRENZE

Histogram Equalization

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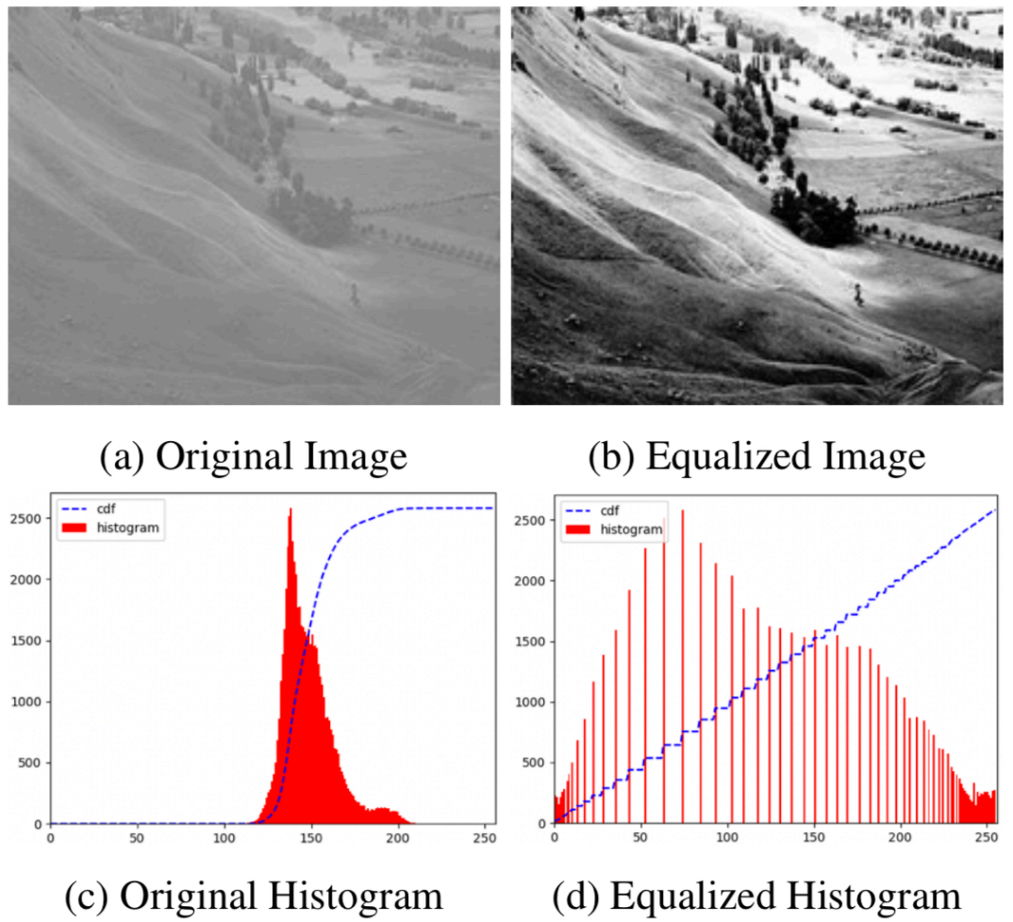
Abstract

- **Image histogram:** type of histogram that acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value.

- **Histogram equalization:** method used in Image Processing through which the contrast can be calibrated using the image histogram.

- **Increases the global contrast:** especially when the usable **data** of the image is represented by close contrast values.

- **Intensities can be better distributed on the histogram:** allows for areas of lower local contrast to gain a higher contrast.



(a) Original Image (b) Equalized Image

(c) Original Histogram (d) Equalized Histogram

Math

- The *probability* of an occurrence of a pixel of level *i* in the image is:

$$p_x(k) = p(x = k) = \frac{n_k}{n} \qquad 0 \leq k < L$$

- *cumulative distribution function*

$$cdf_x(k) = \sum_{l=0}^{k} p_x(l)$$

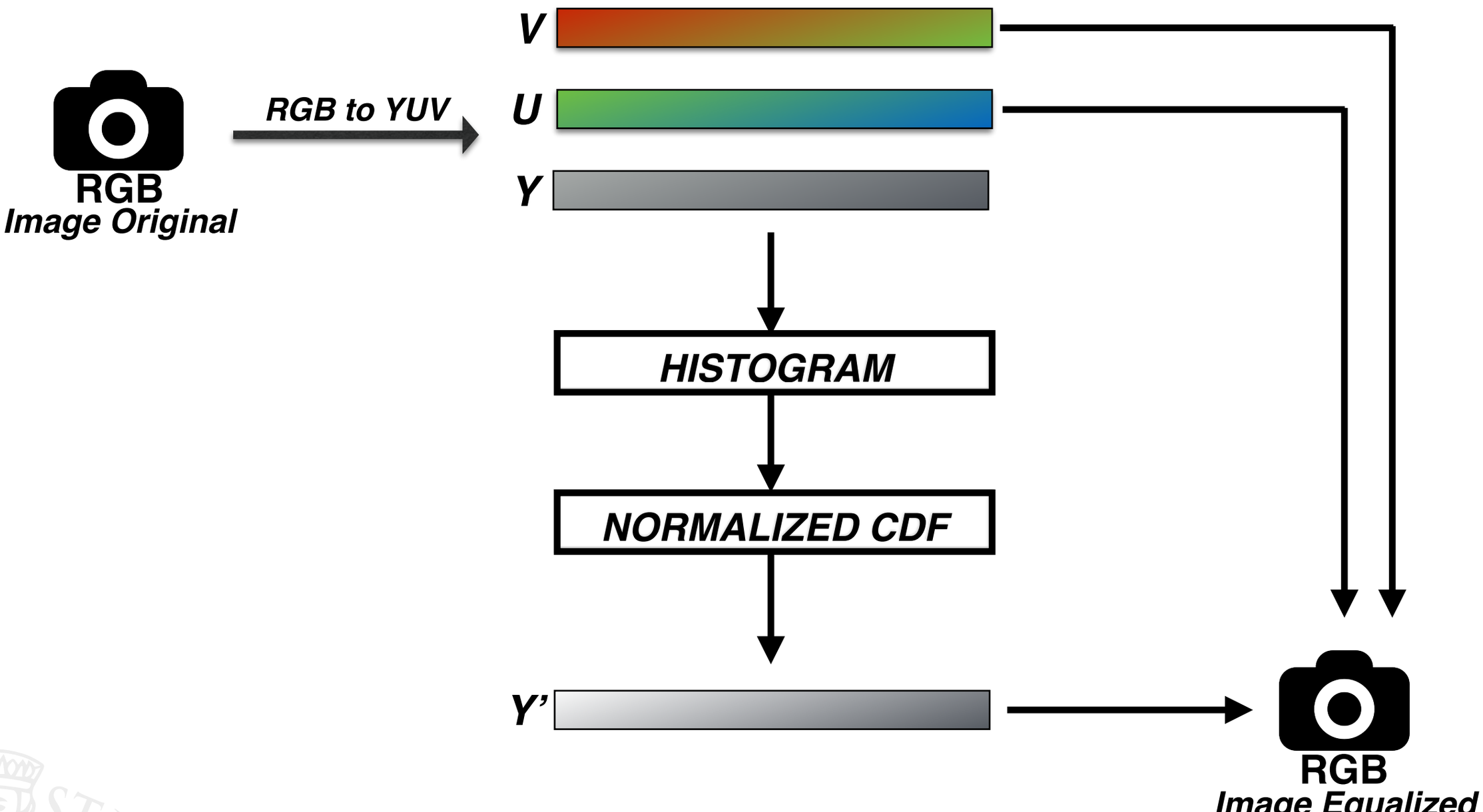
- *normalize* it such that the maximum value is 255 *:*

$$y(i,j) = h(x(i,j) = round\Big(\frac{cdf(x(i,j)) - cdf_{min}}{(M \cdot N) - cdf_{min}} \cdot (L-1)\Big)$$

Technologies

- Sequential Implementation: C++
- Parallel Implementation 1: OpenMP
- Parallel Implementation 2: CUDA

Serial


RGB
Image Original
RGB to YUV
V
U
Y
HISTOGRAM
NORMALIZED CDF
Y'
RGB
Image Equalized