Digital Image Processing
Part 4: Color/Intensity Manipulation

By D.J. Lopez, CCpE, M.Sc.

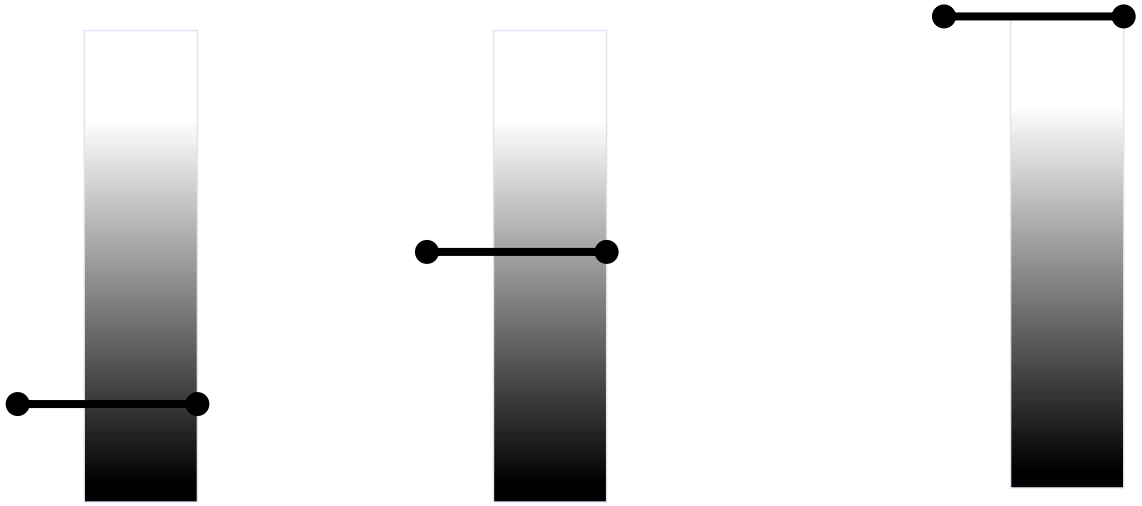
Overview

- Color/Intensity Review
- Motivations for Intensity Adjustment
- Gamma Correction
- Histogram Equalization

Review

Into the Matrix

Channels

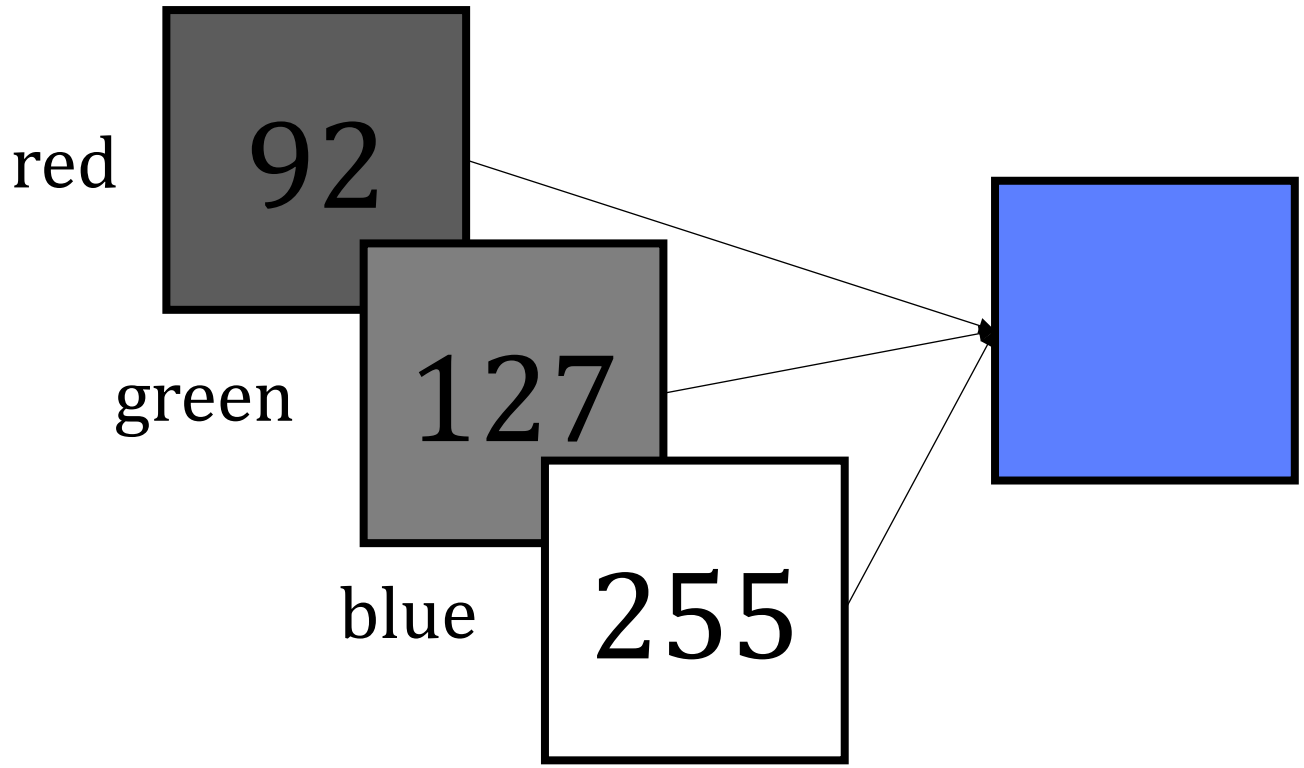


(92,127,255)

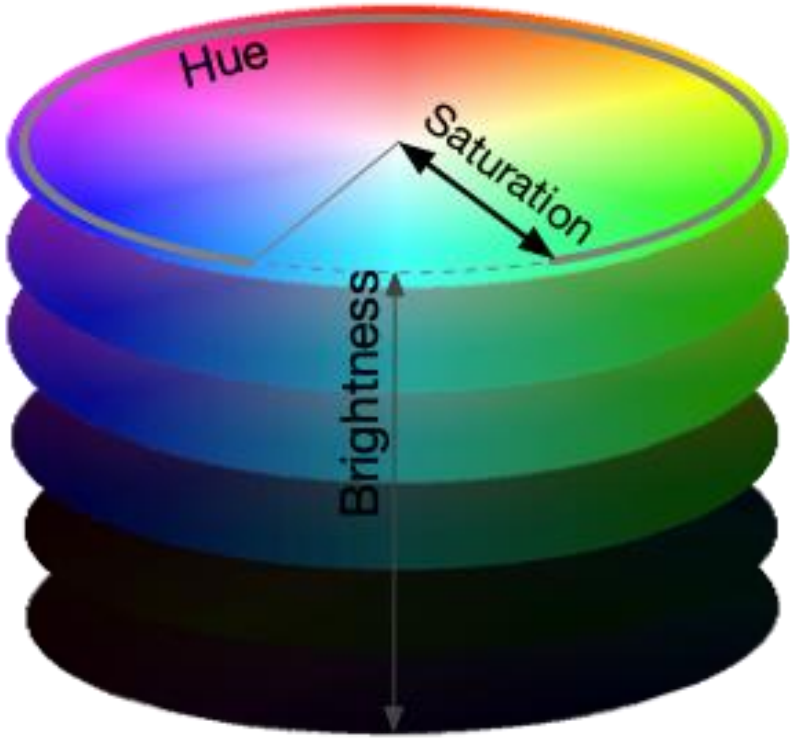
red green blue

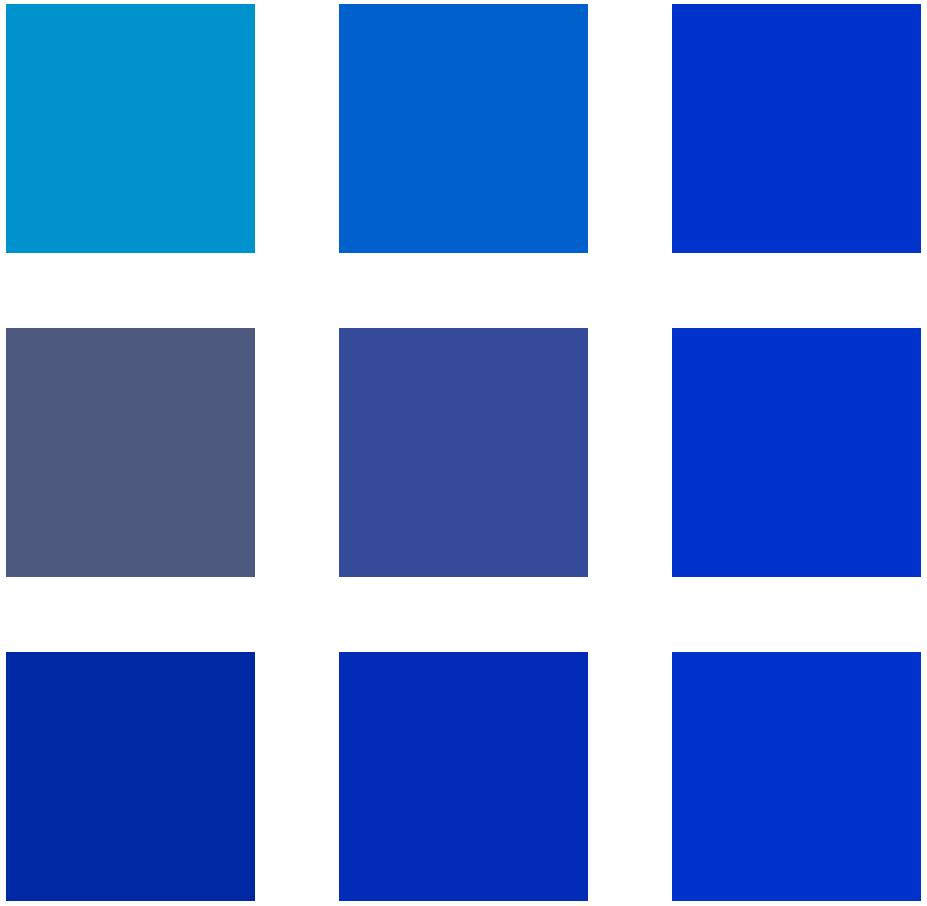
Into the Matrix
Channels

Three-dimensional vector: A Tensor

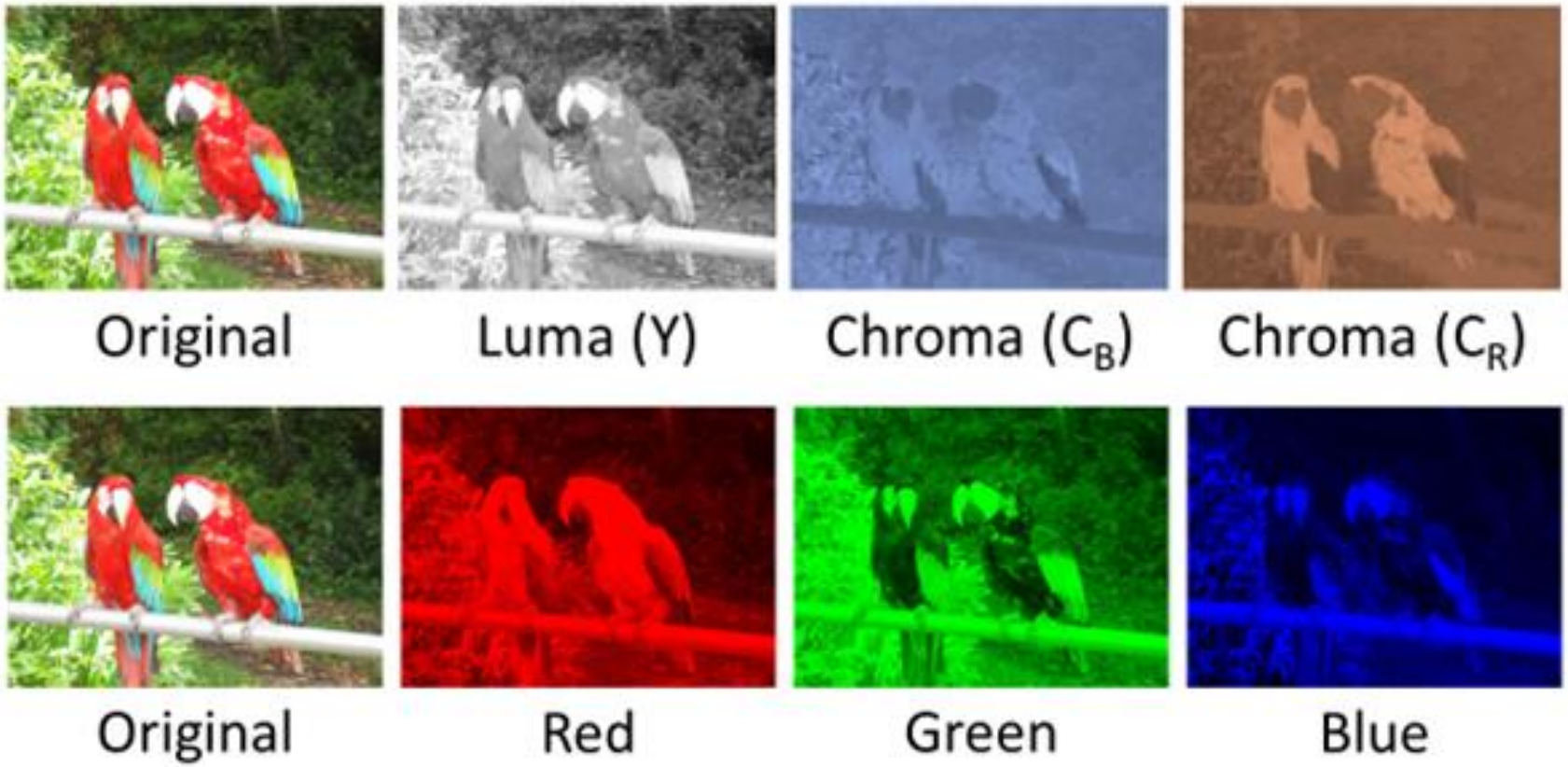


HSL Color System





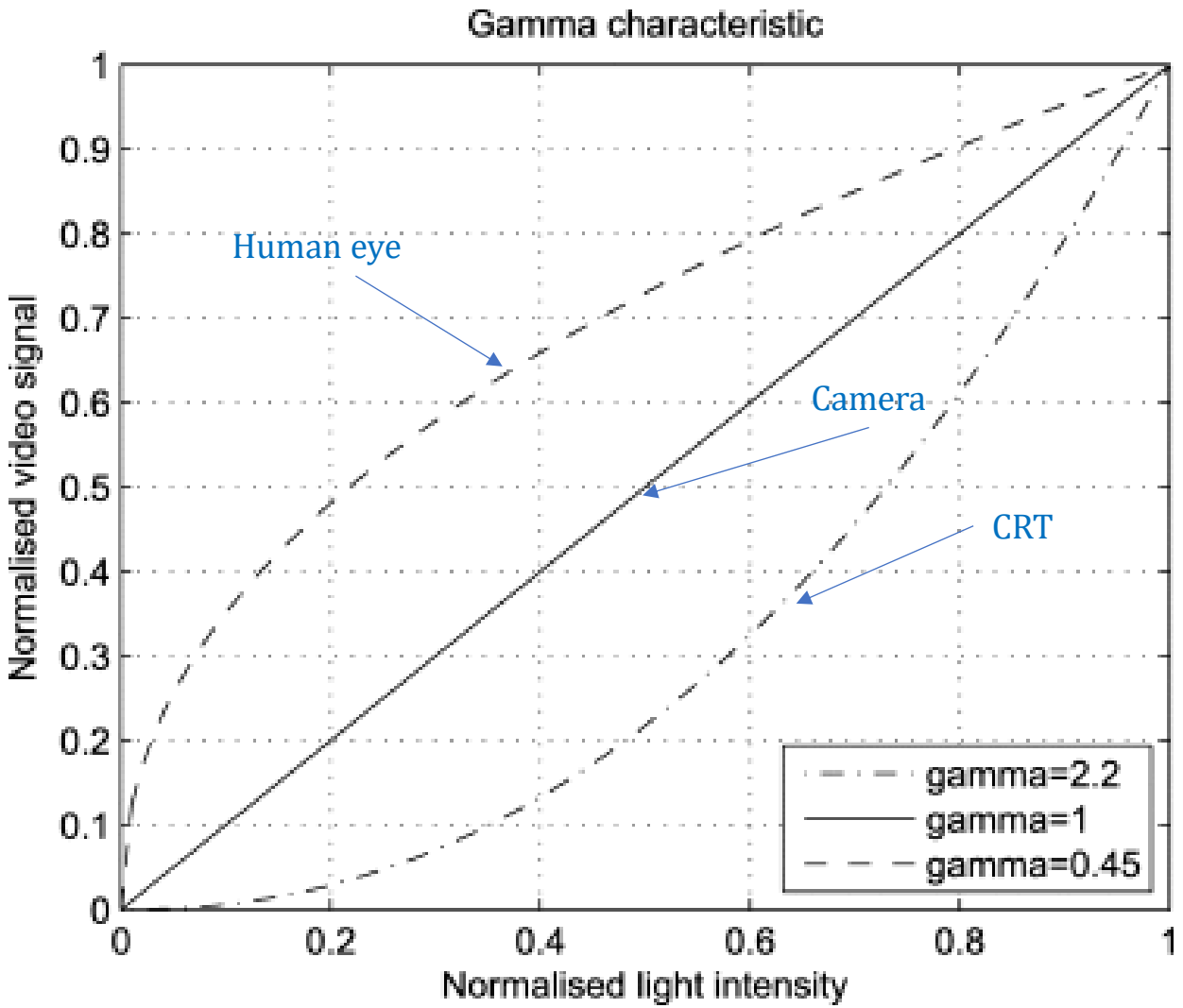
YCbCr Color System



Gamma Correction

Intensity Perception

Luminosity or color intensity does **not have a linear relationship** with human eye perception unlike with photo sensors.



D.R. Bull and F. Zhang (2021) Intelligent Image and Video Compression. Communicating Pictures 2nd Edition

Gamma Encoding

Actual Scale

Linear-Encoded

Gamma-Encoded

Gamma correction function

$$I_\gamma = I_{max} \cdot \left(\frac{I}{I_{max}} \right)^{1/\gamma}$$

Where

I_γ is the gamma corrected intensity

I is the original intensity

I_{max} is the maximum intensity value

γ is the Gamma value

Q: What are the allowed values of γ?

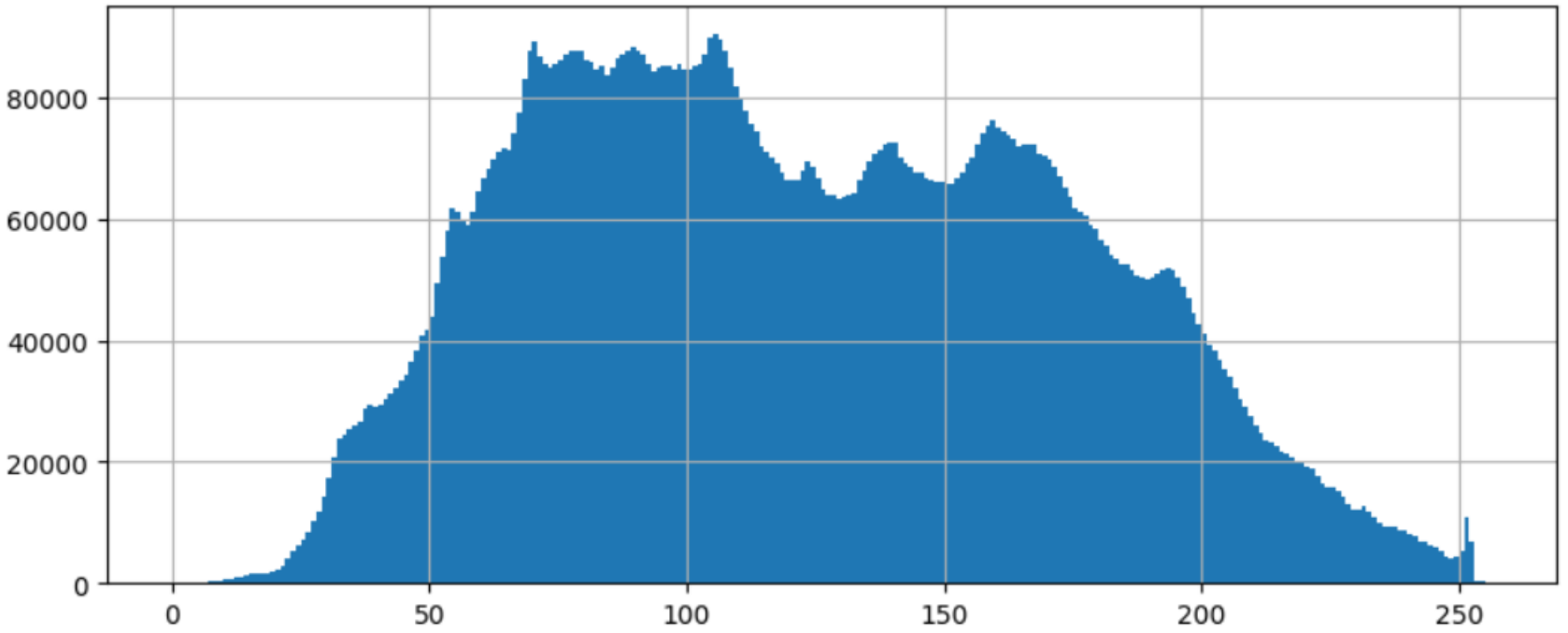
Histogram Equalization

Image Statistics

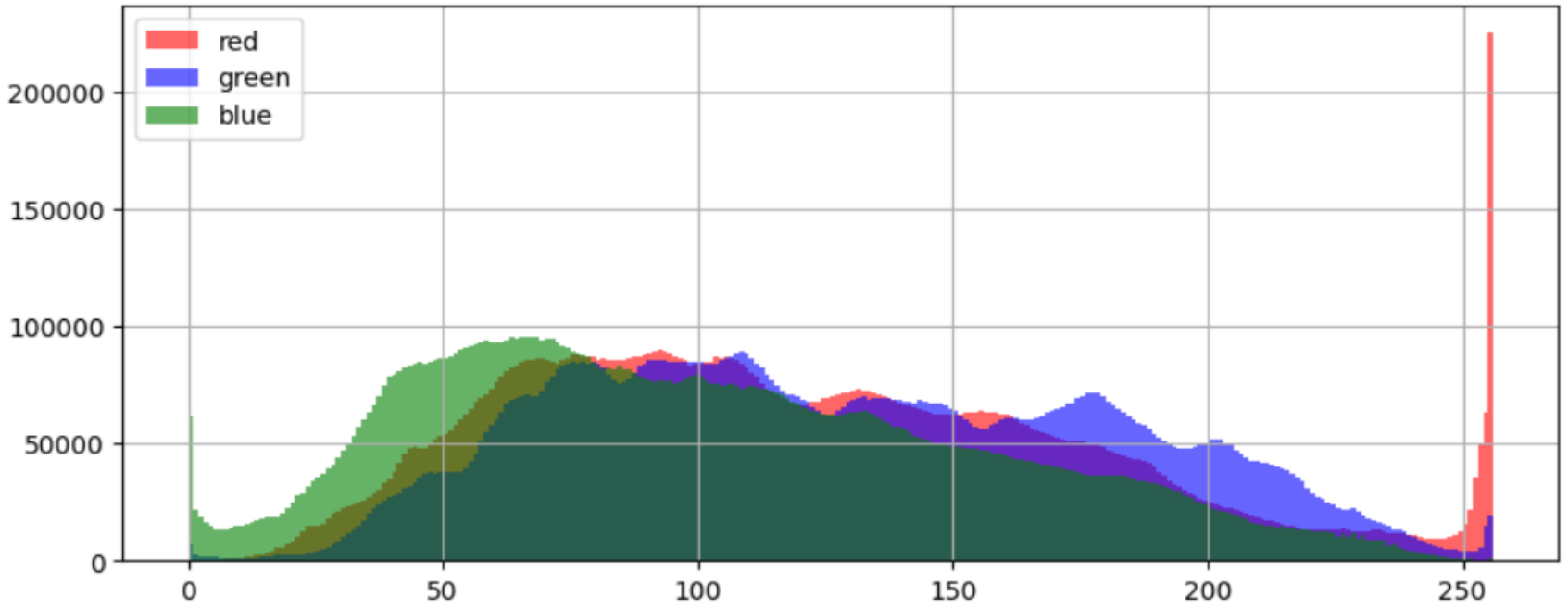
Descriptive statistics can be applied in analyzing static images. This may include the central tendencies of colors, intensities, or location of pixels.

Frequency analysis according to color values can be done using **histograms**

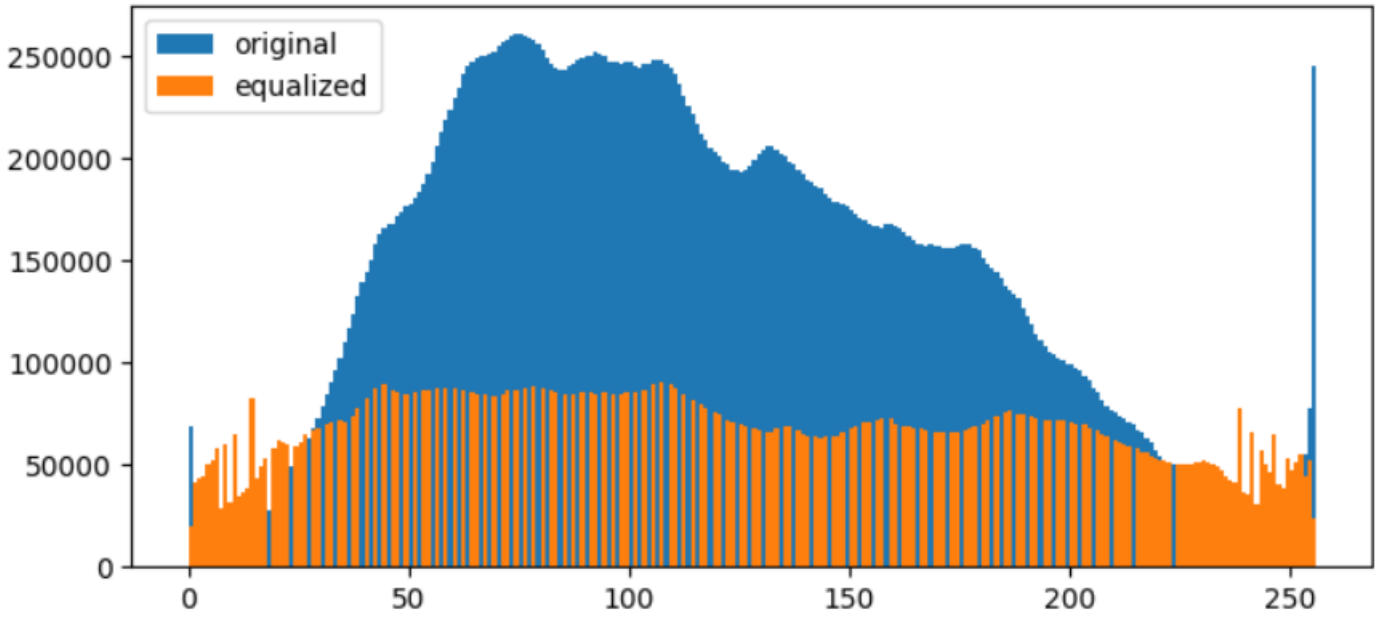
Single-channel Histograms



Multi-channel Histograms



Histogram Equalization (Grayscale)

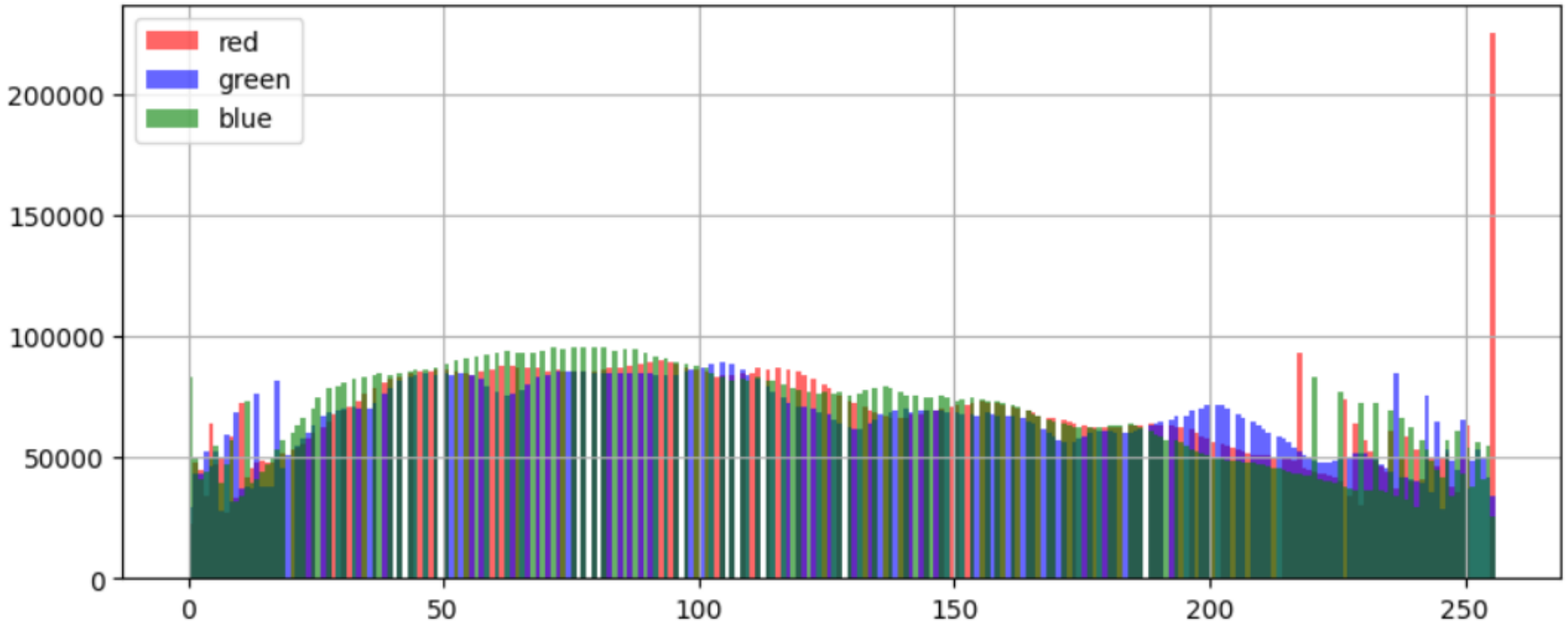


Histogram Equalization (RGB)

Original Image

Equalized Image

Histogram Equalization (RGB)

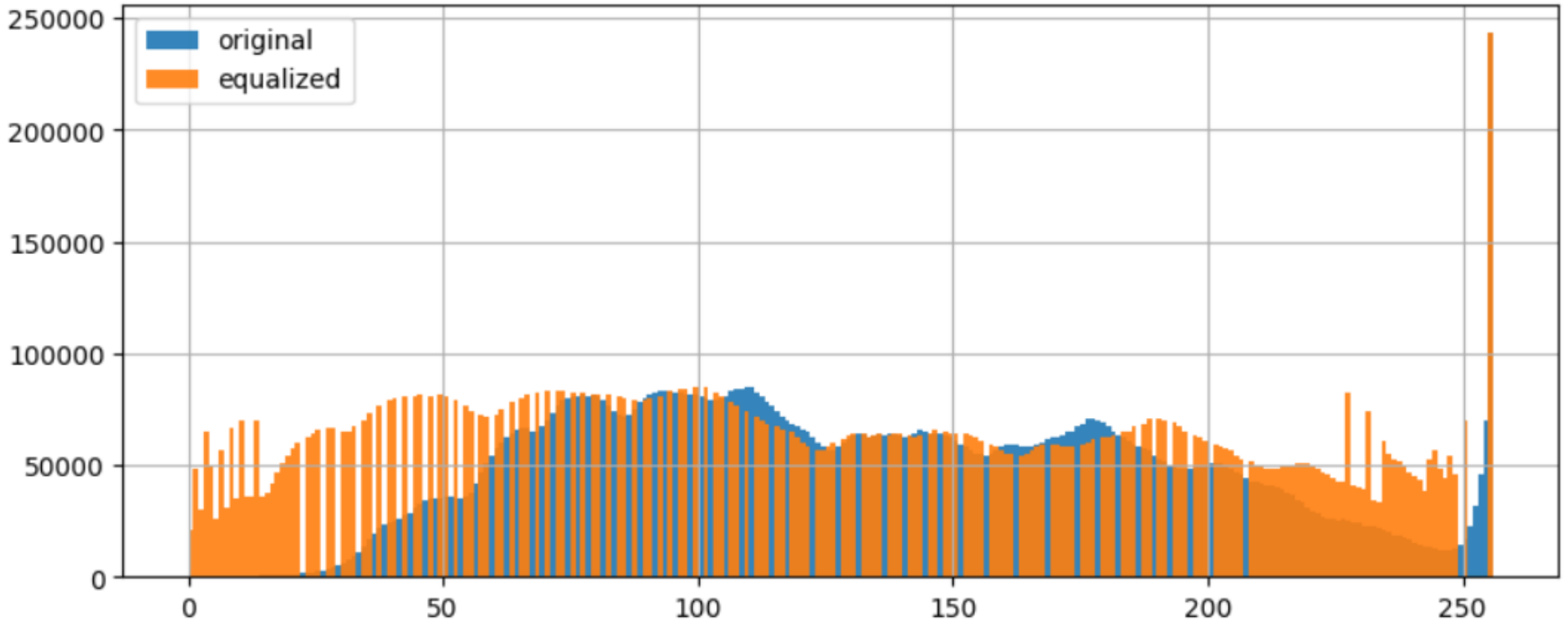


Histogram Equalization (HSL)

Original Image

Equalized Image

Histogram Equalization (HSL)



Thank you