

Notes

Pixels $\underline{C_i} = (R_i, G_i, B_i)$

$$i = 0, \dots, N_x * N_y - 1$$

Brightness (Gain)

$b = \text{brightness}$

$$C_i \leftarrow C_i * b$$

$$R_i \leftarrow R_i * b$$

$$G_i \leftarrow G_i * b$$

$$B_i \leftarrow B_i * b$$

$b > 1 \rightarrow$ brighter
 $0 \leq b < 1 \rightarrow$ darker

Bias $(\beta_R, \beta_G, \beta_B)$

$$R_i \leftarrow R_i + \beta_R$$

$$G_i \leftarrow G_i + \beta_G$$

$$B_i \leftarrow B_i + \beta_B$$

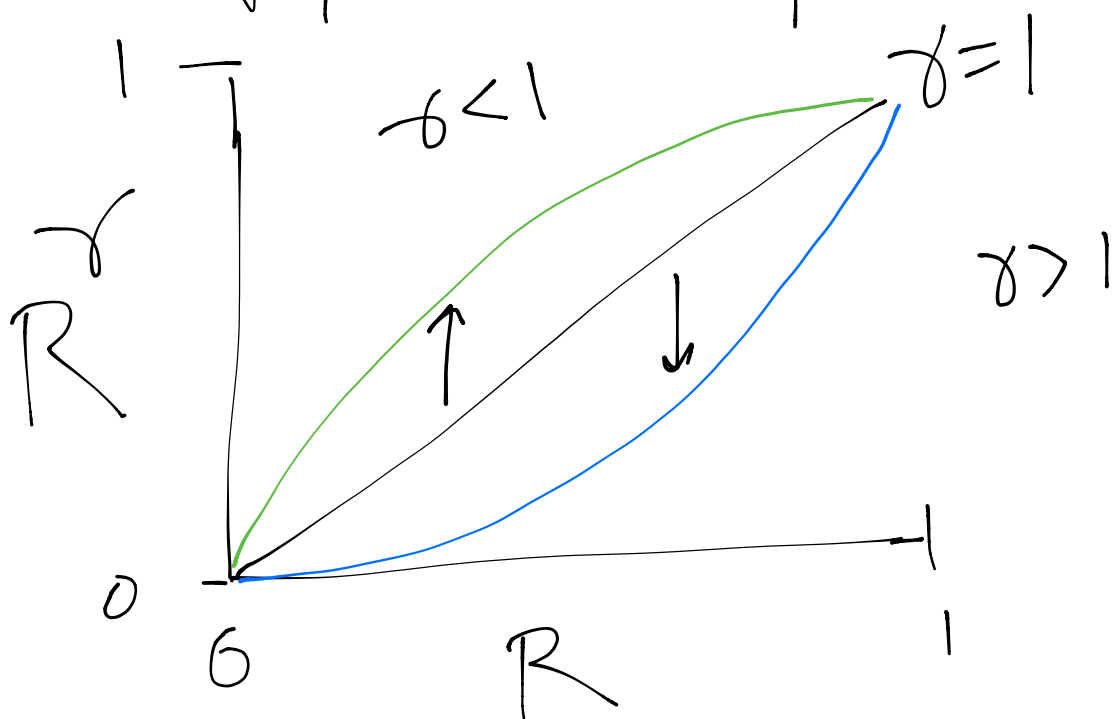
Gamma
power $(0 \leq \gamma < \infty)$

$$C_i \leftarrow C_i^\gamma$$

$$R_i \leftarrow R_i^\gamma$$

$$G_i \leftarrow G_i^\gamma$$

$$B_i \leftarrow B_i^\gamma$$



Compliment

$$C_i \leftarrow 1 - C_i$$

$$R_i \leftarrow 1 - R_i$$

$$G_i \leftarrow 1 - G_i$$

$$B_i \leftarrow 1 - B_i$$

Quantize

$N = \#$ step of color

$$R_i \leftarrow [R_i * N] / N$$

$[] = \text{integer part}$

$$G_i \leftarrow [G_i * N] / N$$

$$B_i \leftarrow [B_i * N] / N$$

$$R = 0.532$$

$$N = 5$$

$$R * N = 2.66$$

$$[R * N] = 2$$

$$[R * N] / N = 2 / 5 = 0.4$$

Grayscale

$$\begin{aligned} I &= 0.2126R \\ &+ 0.7152G \\ &+ 0.0722B \end{aligned}$$

$$\text{Sum} = 1$$

$$C = (g, g, g)$$

$$c_i = (1, 1, 1)$$

$$g = 1$$

Color Space

Hue Saturation Value
HSV

$$C = (R, G, B)$$

$$C_{\max} = \max(R, G, B)$$

$$C_{\min} = \min(R, G, B)$$

$$\Delta = \underline{C_{\max} - C_{\min}}$$

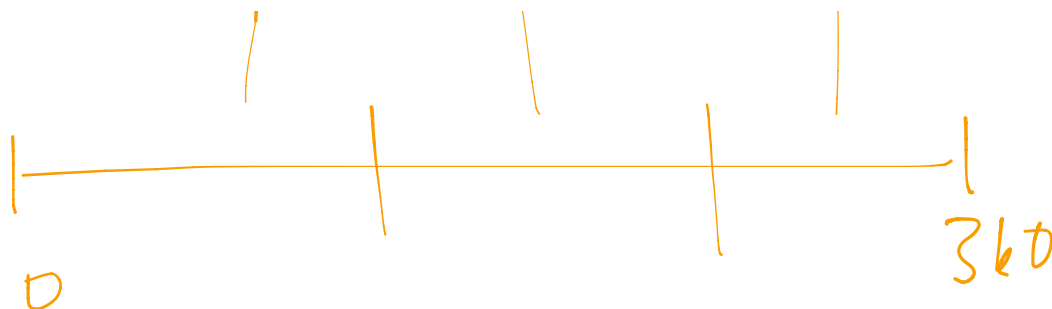
$$\text{Saturation} = \Delta / C_{\max}$$

$$\text{Value} = \underline{C_{\max}}$$

$$h_{ux} = \begin{cases} 0 & \text{if } D = 0 \\ \left(\frac{G-B}{D} \right) 60 + 360 & \text{if } C_{max} = R \end{cases} \% 360$$

$$\left(\frac{B-R}{D} \right) 60 + 120 & \text{if } C_{max} = G \% 360$$

$$\left(\frac{R-G}{D} \right) 60 + 240 & \text{if } C_{max} = B \% 360$$



CMYK
cyan magenta yellow
black

$$K = 1 - \max(R, G, B)$$

$$C = (1 - R - K) / (1 - K)$$

$$M = (1 - G - K) / (1 - K)$$

$$Y = (1 - B - K) / (1 - K)$$

$$R = (1 - K) (\underline{1 - C})$$

$$G = (1 - K) (1 - M)$$

$$B = (1 - K) (1 - Y)$$

$$1 - C = R / 1 - K$$

$$1 - M = G / 1 - K$$

$$1 - Y = B / 1 - K$$

$$\max(1 - C, 1 - M, 1 - Y) = \underline{\max(R, G, B)} / 1 - K$$

$$= \frac{1-k}{1-k} = 1$$

International
Commission on
Illumination

CIE

ACES

Academy Color
Encoding System

OpenColor IO

RMS Contrast units


Mean, Standard deviation

Mean

$$\overline{R} = \left(\sum_i R_i \right) / N_x N_y$$

$$\overline{G} = \left(\sum_i G_i \right) / N_x N_y$$

$$\overline{B} = \left(\sum_i B_i \right) / N_x N_y$$

$$\sigma_R^2 = \left(\left(\sum_i R_i^2 \right) / N_x N_y \right) - \overline{R}^2$$


$$\sigma_R = \sqrt{\sigma_R^2}$$

$$\sigma_G^2 = \left(\left(\sum_i G_i^2 \right) / N_x N_y \right) - \bar{G}^2$$

$$\sigma_B^2 = \left(\left(\sum_i B_i^2 \right) / N_x N_y \right) - \bar{B}^2$$

$$\sigma_R, \sigma_G, \sigma_B$$

$$\sigma_R^2 = \left(\sum_i (R_i - \bar{R})^2 \right) / N_x N_y$$

$$\text{Contrast}_i = \left(\frac{R_i - \bar{R}}{\sigma_R}, \frac{G_i - \bar{G}}{\sigma_G}, \frac{B_i - \bar{B}}{\sigma_B} \right)$$

~~B~~ias
Brightness