Color
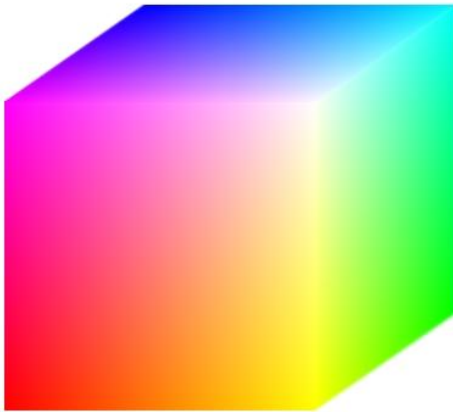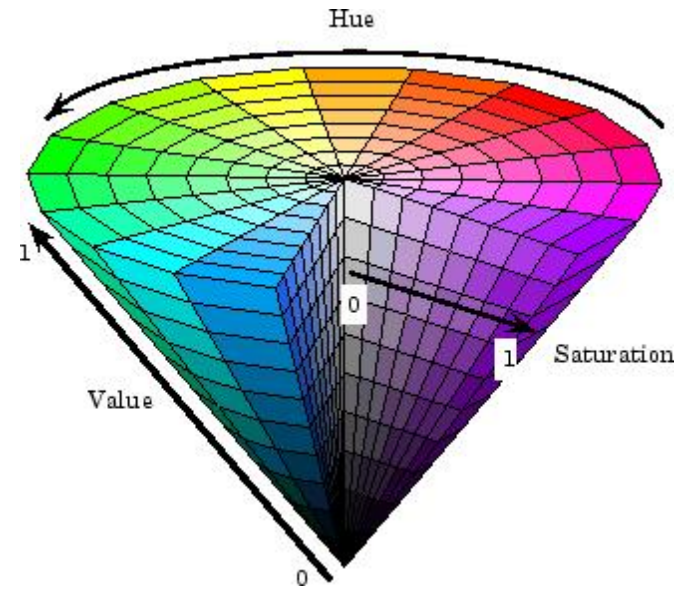
Color Space

- Linear color spaces: RGB
  - Red, Green, Blue
- Nonlinear color space: HSV
  - Hue, Saturation, Value

RGB   HSV

RGB ➡ HSV

$$max = \sup(R,\ G,\ B) \qquad min = \inf(R,\ G,\ B)$$

$$V = max$$

$$S = \begin{cases} \dfrac{max - min}{max} & \text{if } max \neq 0 \\[2mm] 0 & \text{otherwise} \end{cases}$$

$$H_t = \begin{cases} \dfrac{G-B}{max-min} & \text{if} \quad R = max \\[2mm] \dfrac{B-R}{max-min} + 2 & \text{if} \quad G = max \\[2mm] \dfrac{R-G}{max-min} + 4 & \text{if} \quad B = max \end{cases}$$

If $H_t < 0, \quad H_t := H_t + 6$

$$H = H_t \times 60°$$

RGB ➡ Gray

- Typical Grayscale conversion
  - Gray = 0.3 * R + 0.59 * G + .11 * B

- Average conversion
  - Gray = R / 3 + G / 3 + B / 3

Color Histogram

❖ Computing strategy:
  - Naive method: concatenate the histogram of each channel together.

    ⇨Fast, but lost the relationship between different channels of a pixel

  - Quantizing the 3D color space into a certain number of bins and count the total number pixels whose colour value fall into that bin.

    ⇨ accurate, but sometime slow, need some trick.

Color Image
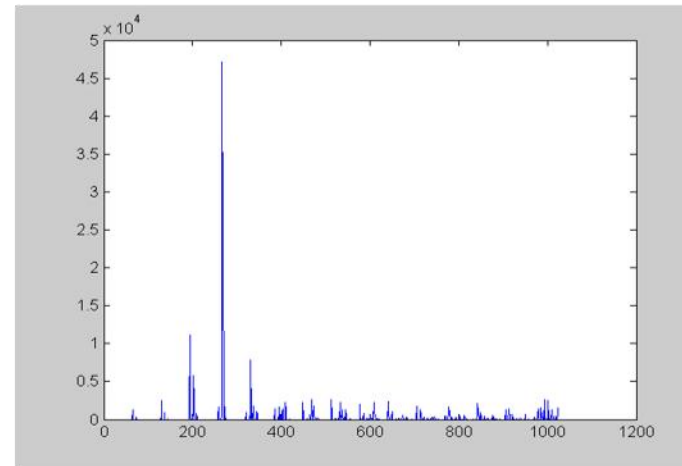
Color Histogram (1024 bins 16*8*8)

Color Histogram

❖ Given two RGB, color pixels, p1 = [3,4,2] and p2 = [6,7,0], what is the index of histogram bins that p1 and p2 would correspond to? (Assume that R, G, B values are octal numbers i.e., 0~7 bases) (3 mins)

Answers:

I1 = 3*8^2+4*8+2 = 226

I2 = 6*8^2+7*8+0 = 440

Hence, the bin number for p1 is 226, and 440 for p2

Exercise

Load image *peppers.png* using *imread('peppers.png');* (matlab Build-in Image), use the function *rgb2hsv()*to converts RGB images to the HSV color space. *hsv2rgb* performs the reverse operation. These commands convert an RGB image to the HSV color space.

1) Display the R, G, B channels individually with each is treated as greyscale images
2) Display the H, S, V channels individually with each is treated as greyscale images

Using the following code to create an RGB image stored in the RGB variable
*RGB=reshape(ones(64,1)*reshape(jet(64),1,192),[64,64,3]);*
Convert it into an HSV image *HSV=rgb2hsv(RGB);* Display the H, S, V channels individually. Compare each channel to the RGB images; this could give you a closer inspection of the HSV color space, and its link to the RGB space. The H,S,V channels could be displayed as follow: