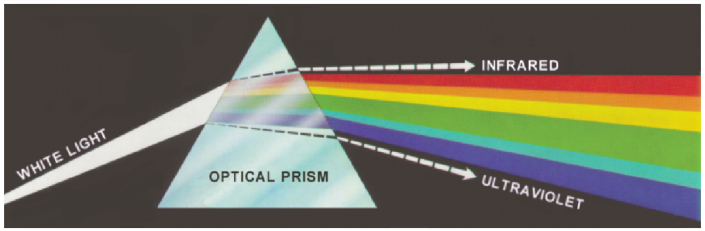
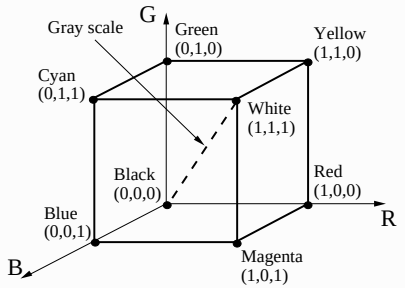
university of groningen

COLOR IMAGE PROCESSING



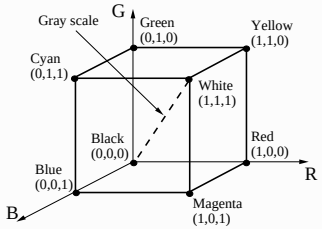
RGB colour model



- any color is written as a sum of the primary colors R(ed), G(reen) and B(lue):

$$Color = r\,R + g\,G + b\,B, \quad r, g, b \in [0, 1] \qquad (1)$$

CMY model



- any color is written as a sum of the primary colors C(yan), M(agenta) and Y(ellow):

$$Color = c\,C + m\,M + y\,Y, \qquad (2)$$

- subtractive model (applies to light reflection from surfaces, e.g. graphics hardcopy devices)

Colour conversion: RGB to CMY

- Linear transformation:

$$\begin{pmatrix} C \\ M \\ Y \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} - \begin{pmatrix} R \\ G \\ B \end{pmatrix}$$

(interchanging colors across the main diagonals)

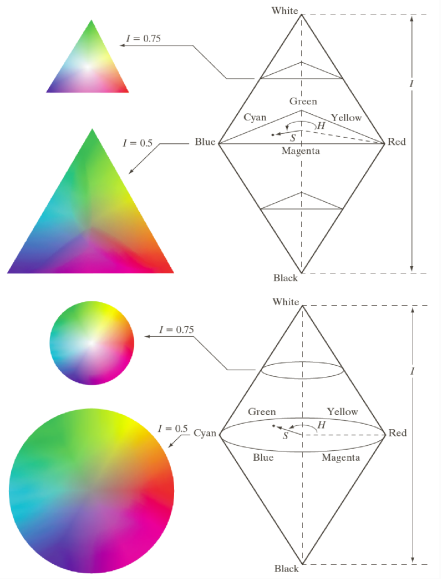
- CMY to CIE: apply CMY to RGB followed by RGB to CIE.

HSI model

- start from a pure color = hue, then add black to obtain shades, or white to obtain tones of that color
- Parameters: Hue (a pure color), Saturation (purity of the color), and Intensity (intensity of a color).
- HSI coordinates can be converted to RGB coordinates, and vice versa, but not by a simple linear transformation.
- Related to HSV (Hue-Saturation-Value) color model

HSI model

I along vertical axis, H an angle around this axis, S radial distance from it



Color Image Processing

- Pseudocolor image processing: assign colors to grey values
- Full-color image processing: processing of color images:

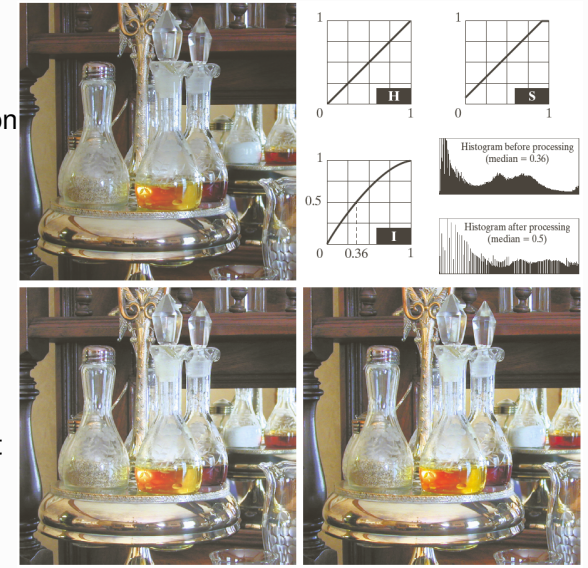
$$\mathbf{c}(x,y) = \begin{pmatrix} R(x,y) \\ G(x,y) \\ B(x,y) \end{pmatrix} \quad x = 0,1,\ldots M-1, y = 0,1,\ldots N-1$$

- Color transformation:

$$\mathbf{g}(x,y) = T[\mathbf{c}(x,y)]$$

Color histogram equalization

Equalization based on the histogram of the intensity in HSI space, followed by saturation adjustment



Color image sharpening

Image sharpening with the Laplacian: $\nabla^2 \mathbf{c}(x,y) = \begin{pmatrix} \nabla^2 R(x,y) \\ \nabla^2 G(x,y) \\ \nabla^2 B(x,y) \end{pmatrix}$

(a) Sharpen each RGB channel. (b) Sharpen HSI intensity component. (c) Difference.