Advanced Image Processing - Color Spaces

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HSV

HSV

HSV is a color model aimed at intuitive use (user-friendly model). Hue determines the position on a color ring, S stands for saturation and V for value, which determines the intensity,

rgb2hsv

rgb2hsv(I) - returns image I in HSV format.

hsv2rgb

hsv2rgb(I_hsv) - does the same but other way around.

HSV - Exercise

HSV

Use the GUI from last week, but instead of RGB sliders use HSV. When displaying the image you have to convert it to RGB before displaying.

CIE Lab

CIE Lab

CIE L* a* b* is a three element model. L stands for luminance, a is position on the green-red axis and b is position on the blue-yellow axis.

rgb2lab

rgb2lab(I) - returns the image I in the Lab format

lab2rgb

lab2rgb(I_lab) - the same but in reverse

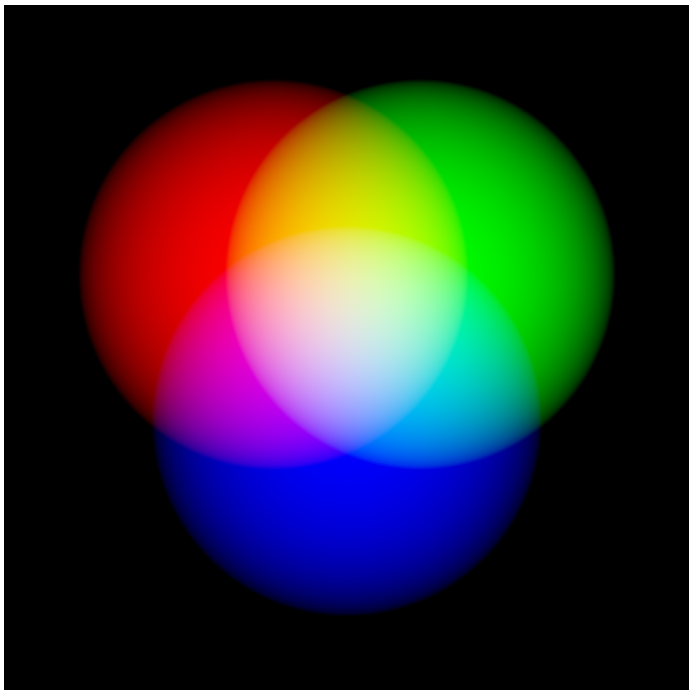
Exercise

Change the GUI so the sliders represent the Lab color space.

RGB

RGB

RGB is an additive model. The colors are added to a black background.



CMY

CMY

CMY is subtractive model, e.g. we add colors on a white background. If we add all of the colors we will get the black color.

CMYK

CMYK also has a black component which is useful for printing applications.

CMY vs. RGB

CMY

Conversion from RGB to CMY C = 255 - R, M = 255 - G a
Y = 255 - B

CMY vs. RGB

CMY

Conversion from RGB to CMY C = 255 - R, M = 255 - G a
Y = 255 - B

RGB

In reverse: $R = M + Y$, $G = C + Y$, $B = C + M$

Euclidian distance

Exercise

Write a scipt which displays the image farby.png and using the function ginput lets user pick three points in the image. Compare the distances of colors for the pairs of points in the RGB, HSV and Lab color spaces. Distance in the Lab spectrum should be the most representative of what humans perceive as similar colors.

Euclidian distance

$$\rho_e(\vec{a}, \vec{b}) = \sqrt{\sum_{i=1}^{n}(a_i - b_i)^2}$$

ginput

[x ,y] = ginput(n) - returns vector x and y with coordinates of n points which are captured in the active figure by user

Pseudocolors

Pseudocolors

We can use pesudocolors to color a grayscale image.

colormap

colormap(map) - changes the map with which the image is drawn. Map can be preset (jet, hsv, copper, winter, gray, bones), or any matrix of shape $n \times 3$ where each row represents an RGB color triple.

Code

```
BW = imread('medical.pgm');
imagesc(BW);
colormap(hsv);
```

Indexed images

Indexed image

Indexed image is an image where each pixel is not represented by an RGB triple, but with a specific image. To draw the image it is necessary to have a map which connects the index with a color. The map is a matrix of of shape $n \times 3$ where each of the n rows represents an RGB color triple.

rgb2ind

[X, map] = rgb2ind(I,n) - returns indexed image X with n colors and a map with shape $n \times 3$.
X = rgb2ind(I,map) - returns indexed image X for a given image I and a map.

imhist

hist = imhist(X,map) - returns a histogram vector for different indices. When there is no return value the histogram is drawn.

Code

```
[X, map] = rgb2ind(I,30);
imagesc(X);
colormap(map);
figure;
imhist(X,map);
```

Exercise

Exercise

Convert the image of zatisie to an indexed one for 20 colors and determine which color is the dominant one (find its RGB tripe). Find out what percentage of the total pixels have this color.

Hint

Use the function max, look it up in help.