Digital Image Processing and Pattern Recognition

E1528

Fall 2021-2022

Lecture 12

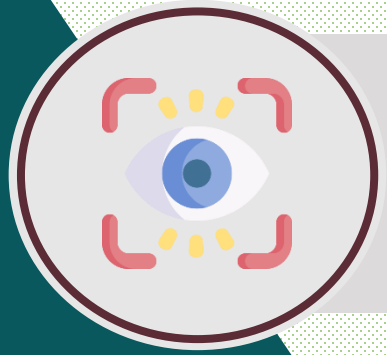
Color Transformations

INSTRUCTOR

DR / AYMAN SOLIMAN

Our Content

Color Complement

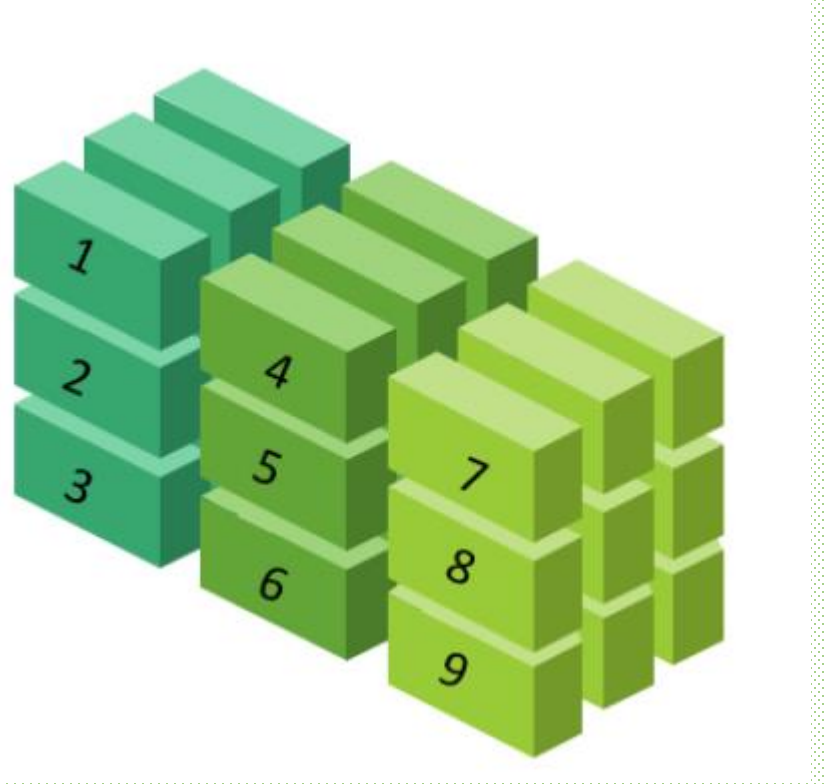


Color Slicing

Tone and color correction

Color Complement 1

Color Complement



An RGB image is basically a 3-D Image array (M*N*3) of color pixel, where each color pixel is associated with three values which correspond to red, blue and green.

So what is color complement?

- **It's the same idea of negative transformation.**
- **subtract each pixel value from the maximum pixel value supported by the class of RGB image.**
- **for 'uint8' class type maximum value a pixel can have is 255.**
- **for 'uint16' class type maximum value a pixel can have is 65535.**
- **Similarly, Maximum possible pixel value in 'double' class type RGB image is 1.0.**

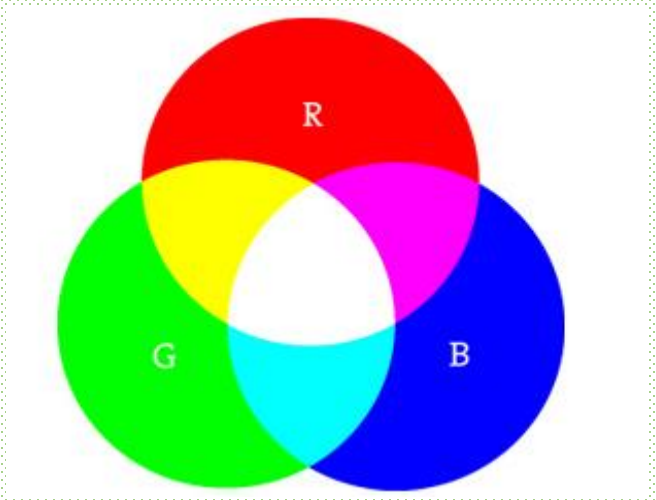
Color Complement

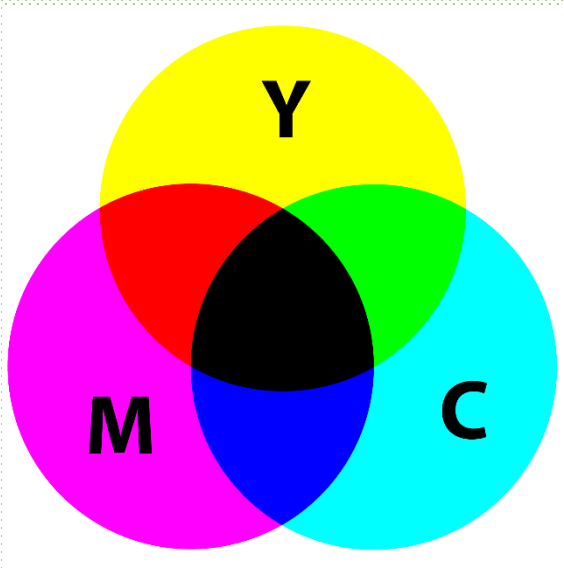
For example:-

Red (255,0,0) → (0, 255, 255) cyan

green (0,255,0) → (255, 0, 255) Magenta

Blue (0,0,255) → (255, 255, 0) yellow





Color Complement

What is the usage of image complement?

The main usage is dark areas become lighter and light areas become darker .

Color Complement

Complementing colors of an RGB Image with MATLAB

```
% read an RGB Image
img=imread('flower.jpg');

% complement colors of RGB image
comp=imcomplement(img);

% Display Complemented Image
imshow(comp);
```

Color Slicing

2

Color Slicing

Idea:
Display the color of interest so they stand out from background

Purpose:

Highlight a specific range of colors in an image in order to separate objects from surroundings.

Color Slicing

1-Cube Transformation

$$s_i = \begin{cases} .5 & if \left[|r_j - a_j| > \frac{W}{2} \right]_{any\ 1 \le j \le n} \rightarrow set\ to\ gray \\ r_j & otherwise \rightarrow keep\ the\ original\ color \end{cases}$$

$$i = 1, 2, 3, \dots, n$$

2-Sphere Transformation

$$S_i = \begin{cases} .5 & if \sum_{j=1}^{n} (r_j - a_j)^2 > R_0^2 \rightarrow set\ to\ gray \\ r_j & otherwise \rightarrow keep\ the\ original\ color \end{cases}$$

$$i = 1, 2, 3, \dots, n$$

Color Slicing

Centered at a= [.6863, .1608, .1922]

W=.2549

R0=.1765

Color Slicing

```
%MATLAB CODE FOR SPHERE COLOR SLICING
a1 = [0.6863*255, .1608*255, .1922*255];
R0 = .1765*255;
m= R0^2;
i=imread('fruit.png');
[rows, columns, numberOfColorChannels] = size(i);
o=i;
for col = 1 : columns
    for row = 1 : rows
        curr_R = double(i(row, col, 1));
        curr_G = double(i(row, col, 2));
        curr_B = double(i(row, col, 3));
        x = (curr_R - a1(1))^2 + (curr_G - a1(2))^2 + (curr_B - a1(3))^2;
        if x > m
            o(row,col,1)=.5*255;
            o(row,col,2)=.5*255;
            o(row,col,3)=.5*255;
        end
    end
end
imshow(o)
```

Tone And Color Correction 3

Tone and color Correction

The model of choice for many color management systems (CMS) is the CIE L*a*b*model also called CIELAB

The L*a*b* color components are given by the following equations:

$$L^* = 116 \cdot h\left(\frac{Y}{Y_W}\right) - 16 \qquad (6.5\text{-}9)$$

$$a^* = 500\left[h\left(\frac{X}{X_W}\right) - h\left(\frac{Y}{Y_W}\right)\right] \qquad (6.5\text{-}10)$$

$$b^* = 200\left[h\left(\frac{Y}{Y_W}\right) - h\left(\frac{Z}{Z_W}\right)\right] \qquad (6.5\text{-}11)$$

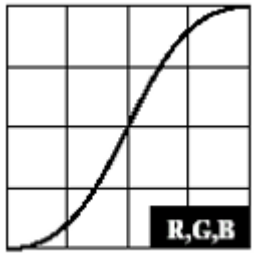
where

$$h(q) = \begin{cases} \sqrt[3]{q} & q > 0.008856 \\ 7.787q + 16/116 & q \le 0.008856 \end{cases} \qquad (6.5\text{-}12)$$

Tonal correction Example

Middle-key Image

Corrected

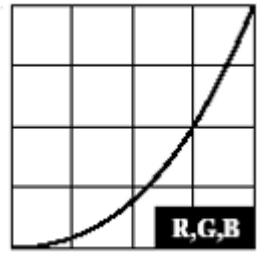


1

Tonal correction Example

Heigh-key Image

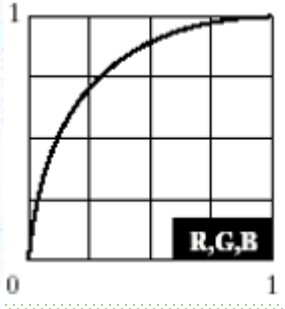
Corrected



Tonal correction Example

Low-key Image

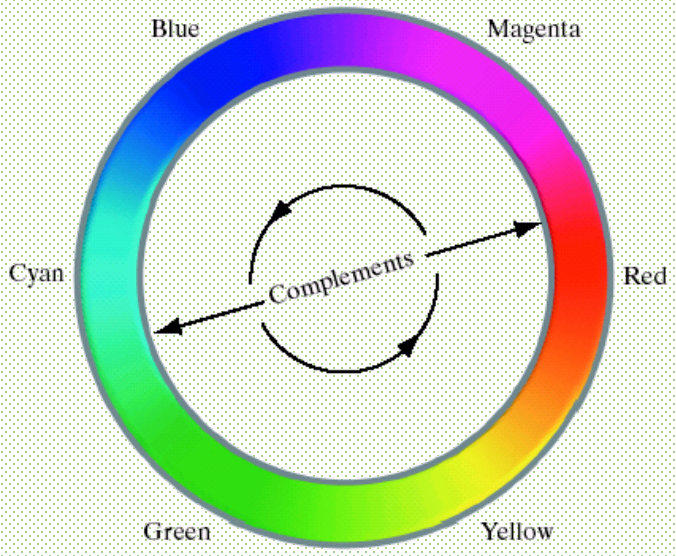
Corrected



Color correction

The proportion of any color can be increased by :

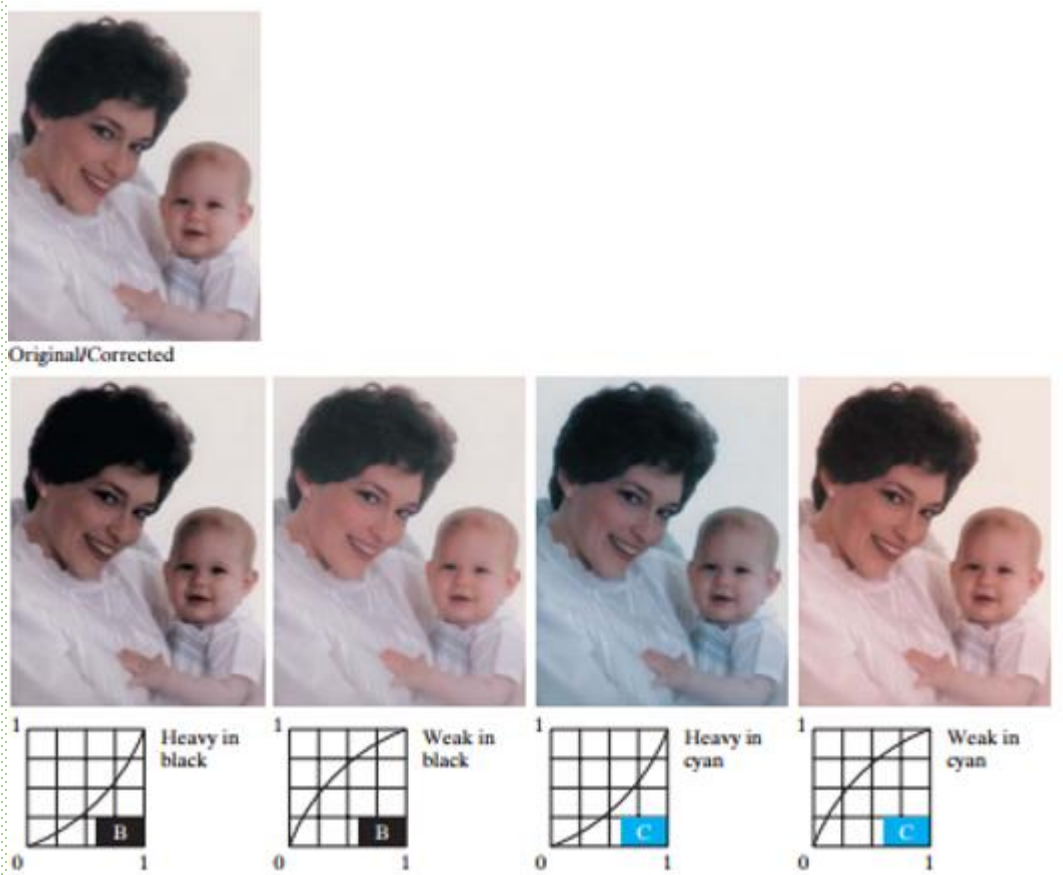
- **decreasing the amount of the opposite (or complementary) color in the image**
- **raising the proportion of the two immediately adjacent colors**



So Magenta can be reduced by:

- **Reduce Red and Blue**
- **Adding Green**

Color correction



Thank you