Computer Vision
Assignment 01

Color Spaces and Skin Tone Characterization

Part I. Warm-up with Color Space Conversion.

Find a color image from the web.

(1) Display the R, G and B channels of the image and their corresponding histograms.

(2) Apply linear transformations of the type $U' = aU + b$ to each color channel (U stands for either R or G or B) and display the resulting color image. How are the channel histograms affected in each case? Comment. *You are free to specify the parameters a, b as you like for each transformation (consider at least two different transformations).*

(3) Convert the orginal image to HSV color space. Repeat (1) and (2) in the HSV color space. *Note that in displaying H, S and V channels you will need to map the H, S, and V ranges you obtain to [0,255] so that you can render the H, S, and V channels.*

(4) Repeat (3) for the YCbCr color space.

(5) Repeat (3) for La*b* color space.

Part II. Implement a Simple Skin Detector.

Find several face photos from the web (as many as you like, the more is better).

(1) Crop the photos or otherwise manually indicate with a painting tool the skin pixels. Basically you will generate a mask that will return the skin pixels only. The rest of the image will be non-skin pixels.

(2) Apply the following RGB to XYZ conversion to the images. *XYZ is a different color space*.

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \frac{1}{0.17697} \begin{bmatrix} 0.49 & 0.31 & 0.20 \\ 0.17697 & 0.81240 & 0.01063 \\ 0.00 & 0.01 & 0.99 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

Then, calculate the so-called *xy*-chromaticity coordinates:

$$x = \frac{X}{X+Y+Z}, \quad y = \frac{Y}{X+Y+Z}, \quad z = \frac{Z}{X+Y+Z}$$

(3) Display the average histogram of *x* and *y* chromaticity values for both skin pixels and non-skin pixels. What differences do you observe?

(4) Devise an algorithm that will find the skin pixels based on the chromaticity distributions you obtained above. You will basically implement a simple skin pixel detector (that you can use instead of manual cropping if it works reasonably well). Show your results on images.