UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES
Département d'informatique

Université de Genève

Département d'informatique

Imagerie Numérique

HVS perception and colors

TP Class N° 2

October 9, 2020

Exercise 1. *(0.86 point)*

(a) What are the main components of the HVS as an optical system? What are the characteristics and limits of each of its components?

(b) How does the human eye sense colors? What are the main qualities of achromatic and chromatic light?

Exercise 2. *(0.86 point)*

In this exercise, you will investigate how changing the values of individual (RGB) color channels affects an image by manipulating *mnms_512.jpg*.
You should write a script that will take one individual color channel and scale it in ten steps to zero while keeping the other two channels untouched. Repeat the process for every three channels. Display the results and comment the effect for each color component.

Exercise 3. *(0.86 point)*

(a) What is the NTSC-YIQ color space? What is the main domain of application for this color system? What is its advantage against RGB from an application point of view ?

(b) Write a function that takes an RGB image and converts it to the NTSC-YIQ format. Pay attention to the image dynamic range (is it from 0 to 1 or from 0 to 255). Convert the RGB image *mnms_512.jpg* to the NTSC-YIQ using your function. Display each three components as individual gray images. Explain the meaning of each component.

NB : If you use the matplotlib library to display grayscale images, pay attention to the color maps (cmap) you are using or you might end up with strange coloured results.

(c) Apply Python function *skimage.color.rgb2yiq* to the RGB image *mnms_512.jpg*. Compare the obtained result with the result of your function and explain the visual differences, if any.

(d) Use the Python function *skimage.color.yiq2rgb* to convert the image back to RGB. Compute the *MSE* between the result image and the original one. Is this color system transformation lossless or lossy?

Exercise 4. *(0.86 point)*

Redo Exercise 3 points (a)–(d) for the YCbCr color system. Use *skimage.color.rgb2ycbcr* and *skimage.color.ycbcr2rgb*.

Exercise 5. *(0.86 point)*

Redo exercise 3 points (a), (b) and (d) for the CMY color system.
NB : since there is no skimage.color.rgb2cmy, you don't need to do part (c). You will need however to write your own function cmy2rgb for part (d).

Exercise 6. *(0.86 point)*

(a) Explain the difference between the CMY and CMYK color spaces.

(b) Redo exercise 5 for the CMYK color space.

Exercise 7. Self research task. *(0.86 point)*

(a) Explain the main diseases of wrong focusing in the HVS. Explain how they are solved nowadays. Present them schematically.
(Hint: emmetropia, myopia, hypermetropia, astigmatism)

(b) What are the main differences between the focusing in the HVS and in modern cameras. Present them schematically.

Submission

Please archive your report and codes in "Name_Surname.**zip**" (replace "Name" and "Surname" with your real name), and upload to `Assignments 2020-2021/TP2: HVS perception and colors` on `https://moodle.unige.ch` before Thursday, October 22 2020, 23:59 PM. Note, **the assessment is based not only on your code, but also on your report, which should include your answers to all questions and the experimental results**.