

TP2_HVS perception and colors

October 20, 2023

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Imagerie Numérique 2023 Automne

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TP Class N°2 - HVS perception and colors

Instructions :

- This TP should be completed and uploaded on Moodle before **Thursday 26 October 2023, 23h59**.
- The name of the file you upload should be **TP2_name_surname.ipynb**.
- If you need to include attached files to you TP, please archive them together in a folder named **TP2_name_surname.zip**.

0.0.1 Exercise 1 :

(1 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?

— Write your answer here —

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

— Write your answer here —

0.0.2 Exercise 2 :

(1 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 ?

— Write your answer here —

(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.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.

[]:

— Write your answer here —

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

[]:

— Write your answer here —

(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?

[]:

— Write your answer here —

0.0.3 Exercise 3 :

(1 point)

Redo Exercise 3 (a)–(d) for the YCbCr color system.

(a) What is the YCbCr 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 ?

— Write your answer here —

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

[]:

— Write your answer here —

(c) Use *skimage.color.rgb2ycbcr* to convert the RGB image *mnms.jpg* to the YCbCr format. Compare the obtained result with the result of your function and explain the visual differences, if any.

[]:

— Write your answer here —

(d) Use `skimage.color.ycbcr2rgb` 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?

[]:

— Write your answer here —

0.0.4 Exercise 4 :

(1 point)

Redo Exercise 3 (a), (b) and (d) for the CMY color system.

NB: You will need however to write your own function `cmv2rgb` for part (d).

(a) What is the CMY 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 ?

— Write your answer here —

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

[]:

— Write your answer here —

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

[]:

— Write your answer here —

0.0.5 Exercise 5 :

(1 point)

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

— Write your answer here —

Redo Exercise 4 (b) and (d) for the CMYK color space.

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

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— Write your answer here —

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

[]:

— Write your answer here —

0.0.6 Exercise 6 :

(1 point)

(a) Outline the primary focusing disorders in the human visual system (HVS). Detail current solutions for each. Organize the information in a schematic format.

Hint: emmetropia, myopia, hypermetropia, astigmatism

— Write your answer here —

(b) Compare focusing mechanisms in the human visual system (HVS) and contemporary cameras. Highlight the key differences.

— Write your answer here —