

Image Processing

Home work 06

Color Spaces

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CIE 1931 XYZ

It's the first quantitative that links the pure physical colors with electromagnetic visible spectrum.[2] This color space allow physical radiation responses to color inks, illuminated displays, recording devices.[2] This model try to imitate the eye cones (LMS-Long,Middle,Short) using XYZ.[2]

CIELUV

CIELUV is simple to compute transformation from the previous one. It's used in computer graphics which deal with colored light.

CIELAB

This color space use L for lightness and a, b for color opponent dimensions. This color space is based on non-linearly compressed coordinates. [3]

CIEUVW

This color space is based on CIE 1960 color space. This color space was invented to have the ability to calculate the color differences without holding luminance as constant.

$$U^* = 13W^*(u - u_0)$$

$$V^* = 13W^*(v - v_0)$$

$$W^* = 25Y^{\frac{1}{3}} - 17$$

Where (u_0, v_0) represent the white point and Y represent the luminous tristimulus value.[4]

RGB

In this color space each pixel is represented by 3 values R:Red, G:green, B:blue. RGB color space is any additive color space based on RGB. RGB is considered as good color model for computer graphics because human visual system works in similar but not identical way.[5]

sRGB

sRGB is in RGB color space, designed by Hewlett-Packard and Microsoft to be used for monitors, printers and Internet.[6]

Adobe RGB

It's an RGB color space developed by Adobe in 1998. It was designed to get the ability to have colors achievable by CMYK color printers. Which means being able to have RGB that represent CMYK for screens. But in the end it encompass about 50% of specified visible colors by CIELAB (Which is more than sRGB) [7]

Adobe Wide Gamut RGB

The wide-gamut RGB color space (or Adobe Wide Gamut RGB) is a RGB color space created by Adobe Systems. This color space provide large gamut (**Gamut** represent the subset of colors that the color space can represent[9]). This color space has wider range than sRGB or Adobe RGB. It encompasses 77.6 % of CIELAB while Adobe RGB 52.1% and sRGB 35.9% [8]

Other RGB spaces

For RGB spaces it's open ended. Because picking new red, green, blue primaries and gamma value a new space could be invented. like ProPhoto RGB color space and Rec. 2020[1]

Luma plus chroma/chrominance

YIQ

YIQ color space is was used in some countries for NTSC TV colors. Y component represent the luma (brightness[10]) **I** represent the in-phase, **Q** represent quadrature, referring to the components used in quadrature amplitude modulation.[11]

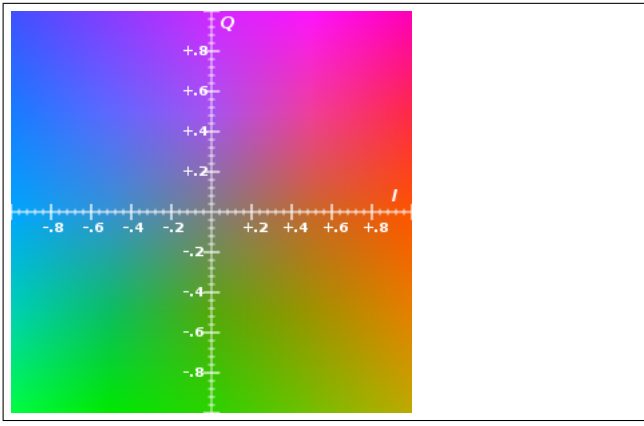


Fig. 1: Colors at $Y=0.5$

Example image showing YIQ components

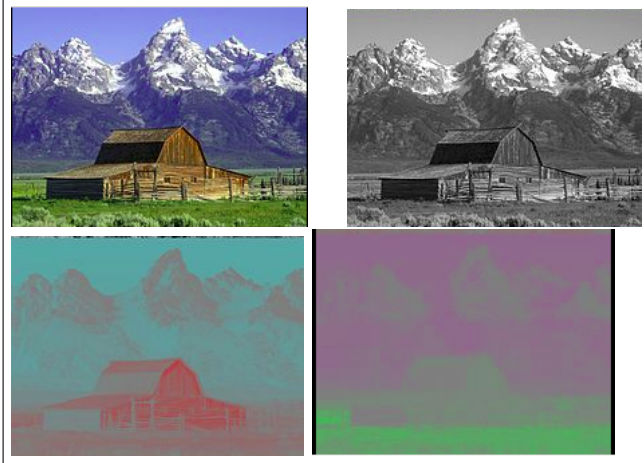


Fig. 2: Show YIQ components

Y'UV

This color space defined in terms Y' for luma or brightness and UV for chrominance components. This color space used for PAL and SECAM video standards. "Previous black-and-white systems used only luma (Y') information. Color information (U and V) was added separately via a sub-carrier so that a black-and-white receiver would still be able to receive and display a color picture transmission in the receiver's native black-and-white format".[12]

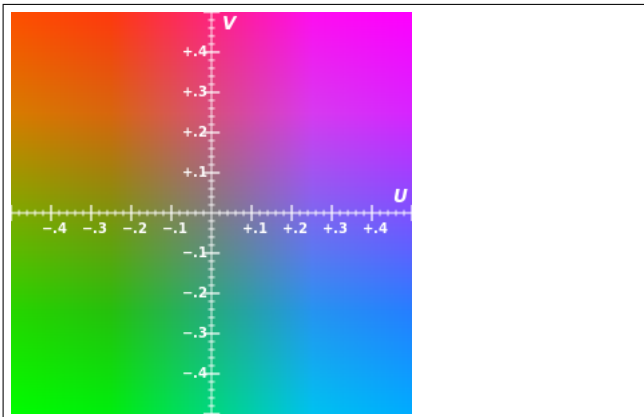


Fig. 3: Colors in $Y'UV$ when $Y'=0.5$

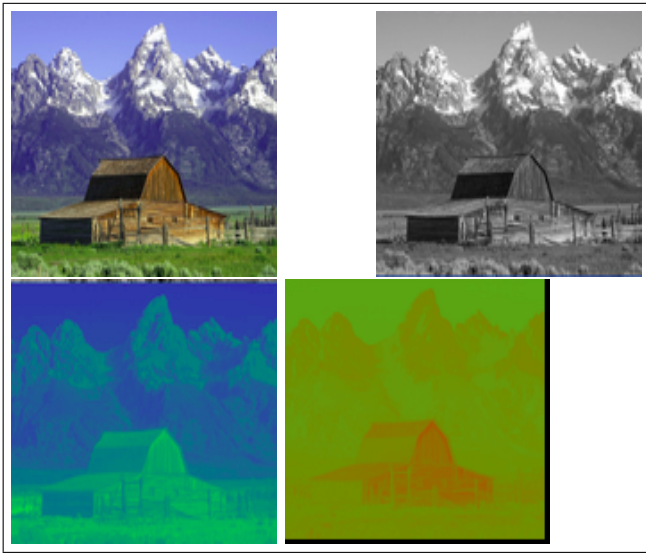


Fig. 4: Show $Y'UV$ components

CMYK

CMYK color model used for printing mainly where CMYK refers to C:Cyan, M:Magenta, Y:yellow, K:Key(black). This type actually describes the printing process itself where the image is disassembled into these colors so the printer can print the image. (Usually inkjet printers have those colors). And the printer also prints the colors in the same order of the abbreviation.[13]

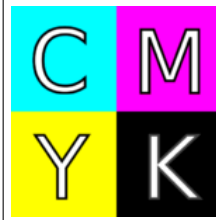


Fig. 5: The CMYK colors

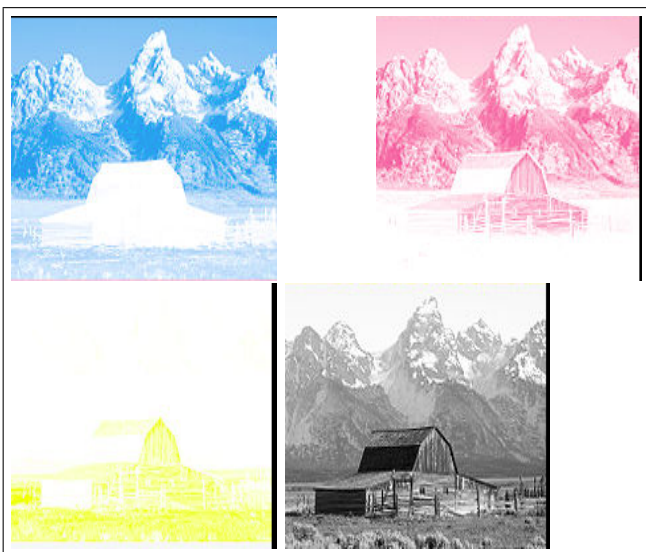


Fig. 6: Show CMYK Components For the same image represented earlier

Note:Only the references in the third page due to lack of space.

References

- [1] Color spaces and there uses
- [2] CIE 1931
- [3] Label Color Space
- [4] CIE 1964 color space
- [5] RGB color space
- [6] sRGB
- [7] Adobe RGB color space
- [8] Wide gamut RGB
- [9] Gamut
- [10] Luma
- [11] YIQ
- [12] YUV
- [13] CMYK color model