Some of the theoretical contents are taken from the instructor manual of the book „Digital Image Processing (4th Edition)“ by Rafael C. Gonzalez and Richard E. Woods. Therefore, the confidentiality class of this document is „internally extended“. The data can be used by OST members as of September 1, 2020, but must not be passed on to third parties.

Image Processing and Computer Vision 1

Chapter 6 – Color Processing – week 13

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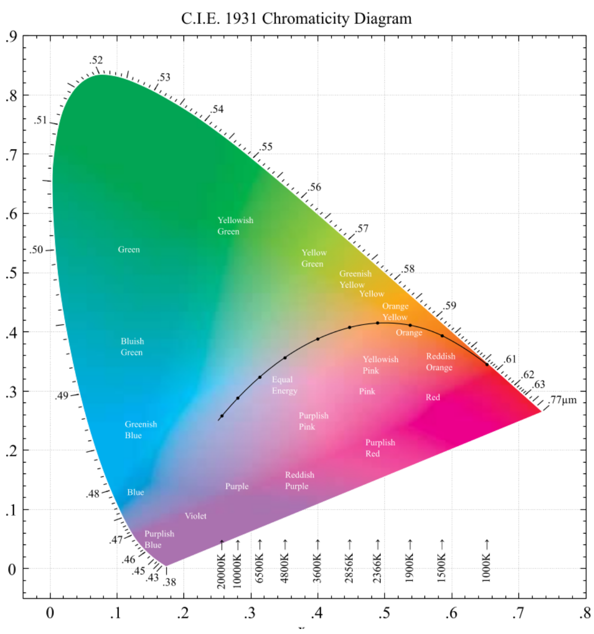
1 Book

1.1 Book by Gonzalez and Woods, 7.2

Consider any two valid colors c_1 and c_2 with the coordinates (x_1, y_1) and (x_2, y_2) in the chromaticity diagram of Fig. 7.5. Derive the necessary general expression(s) for computing the relative percentages of colors c_1 and c_2 composing a given color that is known to lie on the straight line joining these two colors.



Book Fig. 7.5: Chromaticity diagram

Denote by c the given color, and let its coordinates be denoted by (x_0, y_0). The distance between c and c_1 is

$$d(c, c_1) = \left[(x_0 - x_1)^2 + (y_0 - y_1)^2\right]^{1/2}$$

Similarly, the distance between c_1 and c_2 is

$$d(c_1, c_2) = \left[(x_1 - x_2)^2 + (y_1 - y_2)^2\right]^{1/2}$$

The percentage p_1 of c_1 in c is

$$p_1 = \frac{d(c_1, c_2) - d(c, c_1)}{d(c_1, c_2)} \times 100$$

The percentate p_2 of c_2 is then $p_2 = 100 - p_1$. In the preceding equation we see, for example, that when $c = c_1, d(c, c_1) = d(c_1, c_1) = 0$, and follows that $p_2 = 100 - p_1 = 0\%$. Similarly, when $d(c, c_2) = d(c1, c2)$, it follows that $p_1 = 0\%$ and $p_2 = 100\%$. Values in between are easily seen to follow from this simple equation.

1.2 Book by Gonzalez and Woods, 7.4

In an automated assembly application, three types of parts are to be color-coded to simplify detection. However, only a monochrome TV camera is available to acquire digital images. Propose a technique for using this camera to detect the three different colors.

Use color filters that are tuned to the wavelengths of the colors of the three objects. With a specific filter in plcae, only the objects whose color corresponds to that wavelength will produce a significatn response on the monochrome camera. A motorized filter wheel can be used to control filter position from a computer. If one of the colors is white, then the response of the three filters will be approximately equal and high. If one of the colors is black, the response of the three filter will be approximately equal and low.

1.3 Book by Gonzalez and Woods, 7.10

Sketch the HSI components of the image in Problem 7.6 as they would appear on a monochrome monitor.

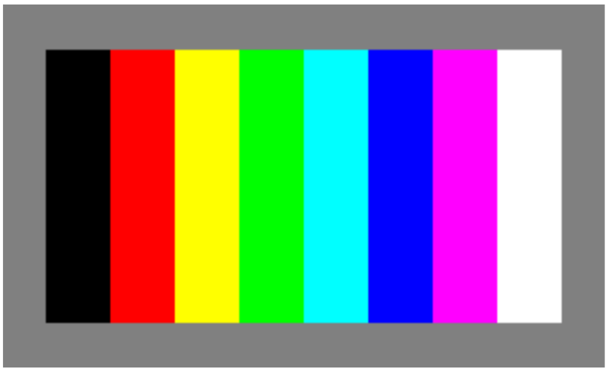


Image of Problem 7.6

Using Eqs. (6-16) through (6-19), we get the results in Table P7.10. Based on Eq. (6-16), we see that hue is undefined when $R = G = B$ because $\theta = \cos^{-1}(0/0)$. In addition, saturation is undefined when $R = G = B = 0$ because Eq. (6-18) yields $S = 1 - (3/0)[\min(0,0,0)] = 1 - (0/0)$. Thus, we get the monochrome display shown in Fig. P7.10.

Table P7.10

Color	R	G	B	H	S	I	Mono H	Mono S	Mono I
Black	0	0	0	-	0	0	-	-	0
Red	1	0	0	0	1	0.33	0	255	85
Yellow	1	1	0	0.17	1	0.67	43	255	170
Green	0	1	0	0.33	1	0.33	85	255	85
Cyan	0	1	1	0.5	1	0.67	128	255	170
Blue	0	0	1	0.67	1	0.33	170	255	85
Magenta	1	0	1	0.83	1	0.67	213	255	170
White	1	1	1	-	0	1	-	0	255
Gray	0.5	0.5	0.5	-	0	0.5	-	0	128

Figure P7.10: Mono TV representation of HSI image. Undefined values are represented with value 128