CIE Chromaticity Diagram in Computer Graphics

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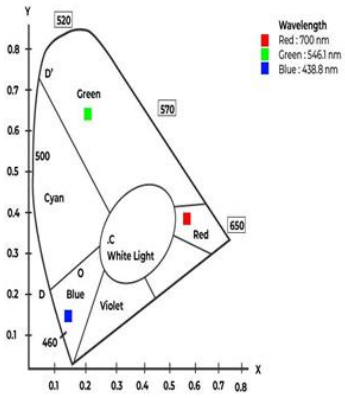
ABSTRACT: The chromaticity diagram represents the spectral colours and their mixtures based on the values of the primary colours(i.e Red, Green, Blue) contained by them. Chromaticity contains two parameters i.e, hue and saturation. When we put hue and saturation together then it is known as Chrominance.
Chromaticity diagram represents visible colours using X and Y as horizontal and vertical axis. The various saturated pure spectral colours are represented along the perimeter of the curve representing the three primary colours – red, green and blue. Point C marked in chromaticity diagram represents a particular white light formed by combining colours having wavelength:
RED: 700 nm
GREEN: 546.1 nm
BLUE: 438.8 nm
In Chromaticity diagram colours on boundary are completely saturated. The corners in this chromaticity diagram represents by three primary colours (Red, Green and Blue).



INTRODUCTION

A diagram was developed by the Commission International L' Eclairage (CIE) which graphically points the eyes response to colours. It is shown in Fig. 13.6. The three standard primaries are imaginary colours. They are defined mathematically with positive color-matching functions that specify the amounts of each primary needed to describe any spectral colour. When we plot the normalized amounts x and y for colors in the visible spectrum, we obtain a tongue shaped curve as shown in Fig. 13.6. This curve is called as the CIE chromaticity diagram. Points along the curve are the "pure" colors in the electromagnetic spectrum, labelled according to the wavelength in nanometers from the red end to the violet and of the spectrum. The line joining the red and violet spectral points called as the purple line, is not the part of the spectrum. Interior points represents all possible visible color combinations. Please observe that the point V in Fig. 13.6 corresponds to the white-light position.

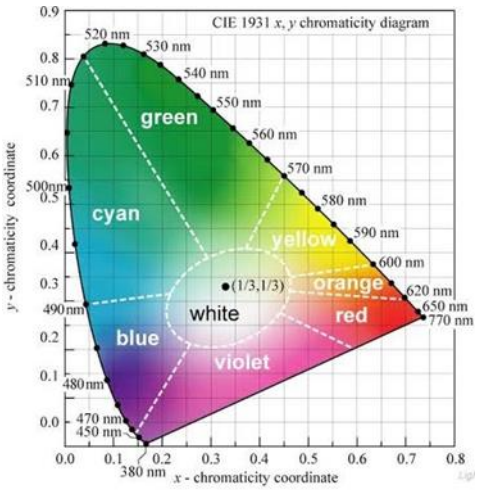


Fig. 13.6.

The chromaticity diagram is useful for the following:

• Comparing color gamuts for different sets of primaries.
• Identifying complimentary colors.
• Determining dominant wavelength and purity of a given color.
• Color gamuts are represented on the chromaticity diagram as straight line segments or as polygons. All colors along the line joining points C_1 and C_2 in Fig. 10.12. can be obtained by mixing appropriate amounts of the colors C_1 and C_2. If a greater proportion of C_1 is used, the resultant color is closer to C_1, than to C_2.
• The color gamut for three points, such C_3, C_4 and C_5 in Fig. 13.7, is a triangle with vertices at the three color positions. Three primaries can only generate colors inside or on the bounding edges of the triangle. Thus, the chromaticity diagram helps us to understand why no set of three primaries can be

additively combined to generate all colors, since no triangle within the diagram can encompass all colors. Color gamuts for video monitors and hard-copy devices are conveniently compared on the chromaticity diagram.

Since the color gamut for two points is a straight line, complementary colors must be represented on the chromaticity diagram as two points situated on opposite sides of C and connected with a straight line.

When we mix proper amounts of the two colors C_1 and C_2 in Fig. 13.8, we can obtain white light. We can also use the interpretation of color gamut for two primaries to determine the dominant wavelength of a color. For color point C_1 in Fig. 13.9 we can draw a straight line from C through C_1, to intersect the spectral curve at point Cs. Color C_1 can then be represented as a combination of white light C and the spectral color Cs. Thus, the dominant wavelength of C_1 is Cs. For any color point, such as C_1 in Fig. 13.9 we determine the purity as the relative distance of C_1 from C along the straight line joining C to Cs.

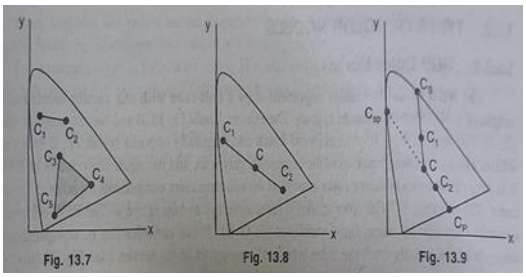


Fig. 13.7 Fig. 13.8 Fig. 13.9

CONCLUSION

In this research paper, we have delved into the significance and application of CIE chromaticity in the realm of computer graphics. The CIE chromaticity diagram serves as a fundamental tool in understanding and representing colors perceptually, laying the groundwork for color reproduction in various digital environments. Our investigation into CIE chromaticity in computer graphics underscores its pivotal role in bridging the gap between human perception and digital representation of colors. By embracing CIE chromaticity principles, we can unlock new possibilities for creative expression, scientific visualization, and technological innovation in the field of computer graphics.

REFERENCE

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