Optical Short Course International

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Who Needs True Color in Their Digitally Projected Images?

Every business and organization who markets products, services, and their brand through the use of common visual media methods needs to project true colors. Like your business.

Can you imagine projecting the Coca-Cola brand image at a large event like the Super Bowl or World Cup and having the Coke red looking like a citrus orange color? You just confused 100 million customers by souring the red brand with a false color orange image, a high leverage, high visibility mistake. Sure you gain you legendary fame in the marketing field as the false color fool of Coke, or worse are dubbed "citrus boy" by your cynical admirers. Of course you might get serendipitously promoted for your chromatic genius if you happened to let this mistake happen at the Orange Bowl college football halftime show.

Picture an architect or interior designer at the crucial presentation of their creative work to their #1 customer after months of creative labor and painstaking color selection and balance. This happens thousands of times every day worldwide. They plug their laptop into the roof mounted projector in the customer's conference room and shazaaam! On the opening slide of their master piece they are suddenly hit with chromatic fever. Their eyeballs twist and contort into a variety of solid geometric shapes in order to shake their retinas awake from their color atrophy. Their stomach knots up because their months of hard work have just been color contorted to the Munsell color chart from hell. Next their complexion runs the whole color range of the spectrum locus of the C.I.E. 1931 chromaticity diagram and stops at bright red. Finally, sweat fills their forehead like they just finished the Boston marathon, as their passionate creative work has been chromatically distorted.

**Who needs true color?   You do!**

A short list of the true color critical industries and functions are listed below:
- Digital Artists
- Computer Animators
- Digital Cinema
- Photographers – Film, Digital
- Printers – Offset Inkjet, Digital
- Scanned Photograph Agency
- Stock Photography
- Brand Marketing of Corporations
- Architects – Residential, Industrial
- Interior Designers
- Illustrators
- Industrial Designers
- Advertising Agencies – Print/Web
- Textile Design & Mfg.
- Clothing Designers
- Digital Product Catalogs – Print/Web

These types of professionals cannot and will not tolerate false colors in the image projections of their creative works. Colors have been used as distinguishing marks in trademarks issued by the US Patent and Trademark Office. Color can be creatively used to direct the attention, convey a mood, symbolize emotions, and create mental states. Color is simply a powerful marketing tool that can visually stimulate psychological affects. True colors and mixtures of colors can accurately create the desired affect. False colors create visual and psychological confusion and unwanted reactions and perceptions in the viewer.

How can we describe the True Colors we <u>Must</u> have and <u>Need</u>?

An international organization called C.I.E. (Commission Internationale de l'Eclairage) developed a quantitative method to describe color precisely on a two dimensional orthogonal XY position chart.

**C.I.E. 1931 Chromaticity Diagram in x y Color Space**
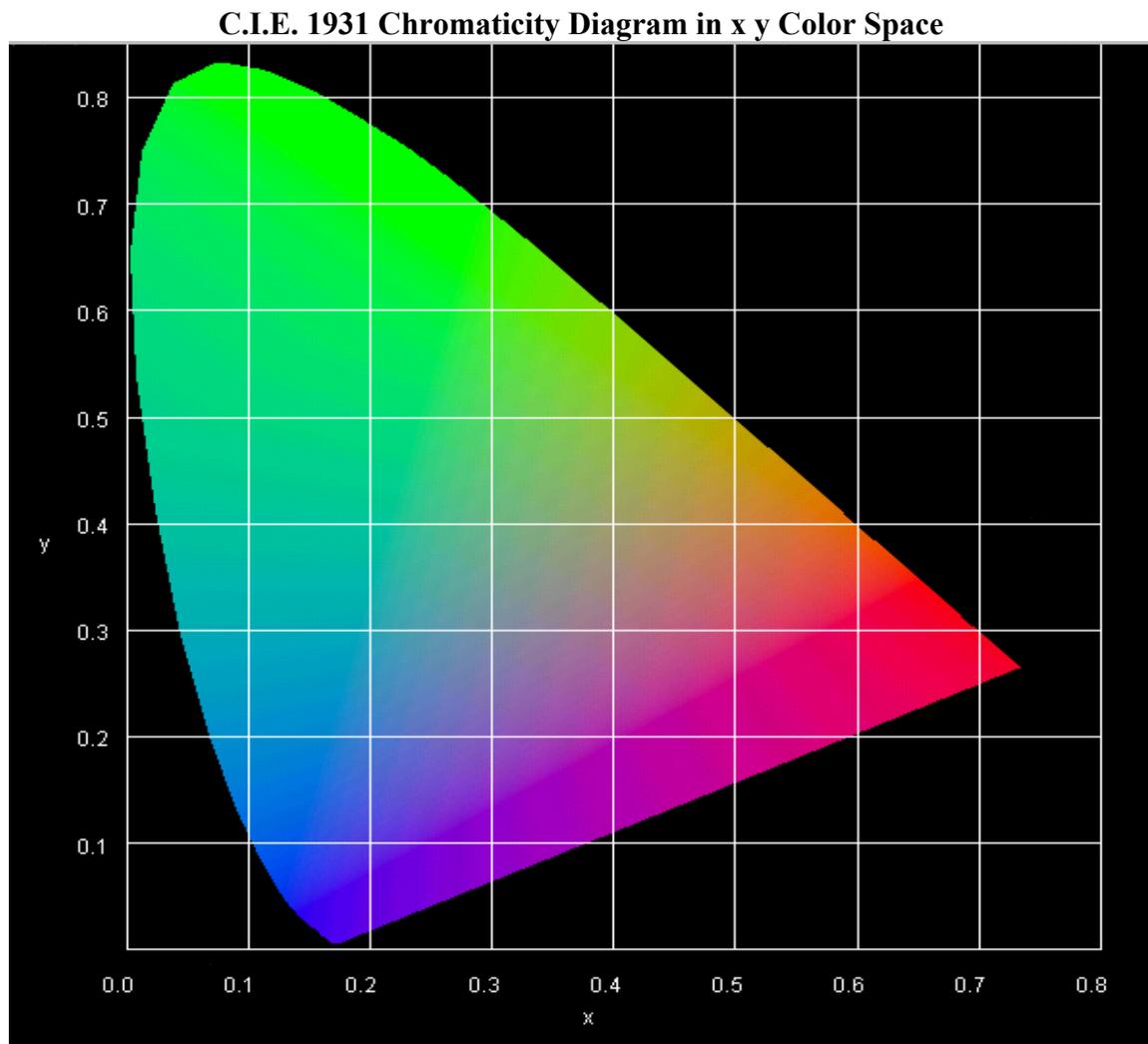
Figure 1. C.I.E. 1931 Chromaticity Diagram

The chromaticity diagram gives us a precise method to quantify the exact color we must have and need for our visual displays, by giving an x and y coordinate. For example x = 0.33 and y = 0.1 gives us a purple. This is more precise than saying "Give me a purple towards violet and with a medium saturation".

What Colors in the C.I.E. Chromaticity Diagram Can Digital Projectors Display?

The current vintage of digital projectors can only display a small limited percentage of the total available color space in the chromaticity diagram. A simple method to quantitatively compare the color gamut of humans to displays is to compare the area of their color gamuts. The color gamut of the typical human observer is the area of the

Current Vintage Digital Projectors Have Ability (sic) To Display ~25% of Human Observer Color Gamut
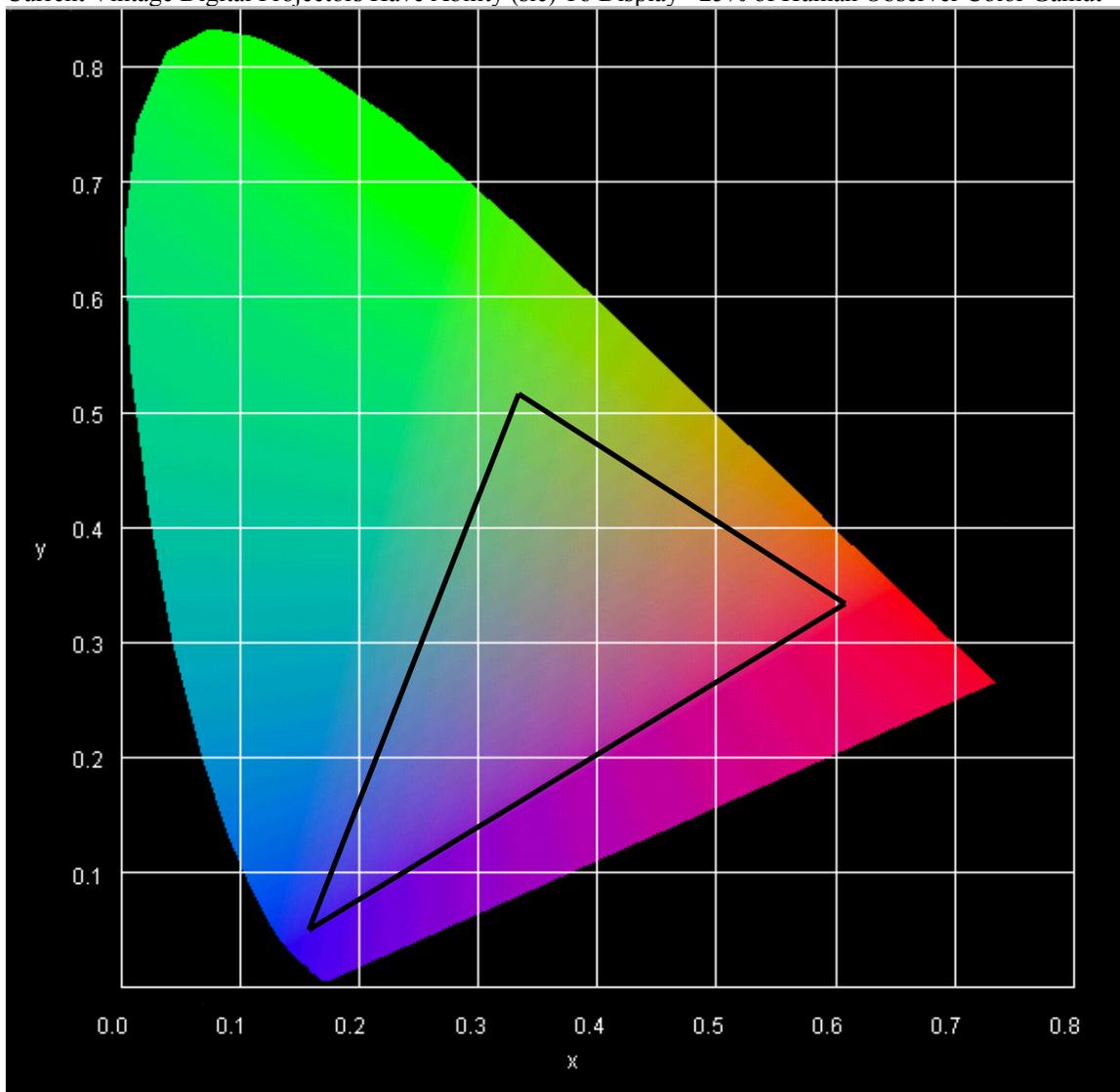
Figure 2. Color Gamut Comparison of Human Eye and Digital Projector

in the chromaticity diagram of Figure 2. This area is called the color gamut of the observer and represents all of the colors that the standard human observer can see if these colors are present in an image. The smaller triangle shown in Figure 2, is the color gamut of a current vintage digital projector. The vertices of the triangle are where the red, green, and blue primary colors are located. In general a display device can display any color within its color gamut or the triangle above by mixing various magnitudes of each of the three primary colors.

We can compare current vintage digital projectors by calculating the area of their color gamut, which is the area of the triangle in Figure 2. The area of the display device can be related to the area or color gamut of the standard human observer. A comparison of the color gamut areas from Figure 2 shows that the current vintage digital projector technology can only display about 25% of the visible colors that one can see with the human eye.

If we try to display a red it will look orange, "citrus boy"! If we want to display a nice purple it will look unsaturated. A nice south pacific white sand beach scene cannot display the true bluish green tropical ocean color. The nice deep dark green of your favorite golf course will look yellowish.

This is certainly not the position we want to be in to display the important creative images of our critical project or hard earned colorful company brand.

What parts of the digital projectors limit the color gamut to only 25% of the standard viewer?

The color gamut of a digital projector depends upon the interplay of a large number of the components in the image color chain. We will not go into the details of each component in the image color chain, in this paper, but we will list them, to give a view of the complexity of the true color objective in digital projectors.

- Digital Image Color Content
- Light Source
- Fold Mirrors & Hollow Integrating Rods
- Color Filters in Color Wheel or Dichroic Filters, Polarization Components, Prisms
- Optical System Spectral Transmission
- Projection Image
- Projection Screen Spectral Transmission/Reflection
- Viewing Environment Color Noise
- Human Visual System

OSCI performs technical consulting to help clients with digital projection systems reach their full color potential. We leverage our alliances with the leading companies in the display industry to achieve these objectives for our clients. We also educate our clients about color in digital projectors with our course Color in Displays. See our website for more details: www.oscintl.com