Prism Projection, Inc.

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An Introduction to TrueSource™

The Problems

With the growing popularity of high intensity LED luminaires, the inherent problems with LEDs have become a real life concern for end users.

Color Consistency

"Not all Red LEDs make the same red."

LEDs are like snowflakes, each one is different. Many are close enough together to cause only the slightest variations in color output. These very similar LEDs are grouped together in manufacturing bins. Binning does solve many of the initial problem of matching LED colors.

LEDs also change with use and environmental concerns such as heat. The individual LEDs will change color and intensity, normally but not always, at a predictable rate. Some manufacturers account for these changes by using preset algorithms that adjust how the LED is driven as it gets older. Basically driving an older LED a little harder at set life increments.

However, life in the real world is much different than computer simulations and lab tests. The form factor of the luminaire, the way LEDs are packaged and how the luminaire is actually used will drastically alter that predictable decay.

These life changes and variations in manufacturing lead to luminaires from the same manufacturer not matching color when given the same control values.

Spectral Response

All color mixing LED luminaires use multiple primary colors. Some may be as simple as using a cool white and a warm white LED to allow for Color Temperature variations. The early LED based “full color” systems used three primary colors, Red, Green and Blue. Many newer LED luminaires will make use of more colors, by adding a white or amber LED to increase the available gamut.

The problem with using a low number of primary colors is that LEDs only emit a very narrow band of color. While traditional lamps emit a full spectrum. With only a few emitters, there are gaps left in the spectrum that leave out spectral response on some colors. The illuminated subject might simply not look “right” or worse actually not reflect the appropriate color and look black.

Every manufacture of subtractive filters provides a Spectral Energy Distribution curve for their products. Unless it is a very saturated color or specifically designed to block certain spectrums, the curve is normally fairly smooth and includes some level of energy from all parts of the spectrum.

SED curves from individual LEDs and even groups of primaries will show significant peaks and valleys.

The traditional measure of Spectral Response is a scientific test called Color Rendering Index (CRI). CRI is a scale from 0 - 100. A score of 100 means that the source matches or exceeds the color response of a tungsten based source. It is very possible, and normally probable that an LED based system will have some spectral energies above the established tungsten curve. While this may lead to an aesthetically pleasing light for some individuals, the luminaire is not performing in line with a traditional tungsten source.

Its important to note that high Color Temperature luminaires and the sun have a spectral curve that is much flatter with even amounts of energy across the spectrum, while tungsten curves towards red.

Also of note is that generally higher efficiency systems have lower CRI. This is true with white LEDs and especially fluorescent tubes. The addition of a white LED to a three color system does give the luminaire a broader gamut with the pastel type colors, but parts of the spectral response expected of lighter colors may not actually be present.

Beam Consistency and Shadows

Most LED color changing systems are built around a light engine that is an array of sources. All the emitters are on a flat plane together. This means several if not hundreds of light sources are pointed in roughly the same direction. This plane of sources projects a light that produces multiple shadows. In some of the worst offenders a rainbow fringed shadow is produced. While lensing and diffusions can minimize the fringe shadows, the shadow is still no where near what would be expected from smaller source tungsten luminaire or the sun. These flat plane devices may look stunning on a smooth surface, but are generally problematic when lighting dimensional objects and people.

While LEDs are rapidly advancing in brightness everyday, commercially available sources are still relatively low output on an individual basis. Requiring luminaire designers to use multiple sources to achieve useful brightness and color gamut.

Because it is challenging to have multiple sources close enough together, the field flatness of the luminaire will also suffer. Again this can be minimized with the use of diffusion and diffusion based lensing, the shadow rarely matches what is possible from a conventional source. For modern lighting designers it is easier to start with a flat field and add patterns or intensity levels to create a desired texture, instead of starting with an unknown or unpredictable field texture.

TrueSource™

After significant research and development efforts, Prism Projection has solved these problems and developed the TrueSource system. TrueSource assures color consistency by utilizing active live color metering, achieves a full spectral response by using carefully selected multiple primary emitters and provides a consistent flat field with next generation optics and reflector systems.

Live Color Metering

At the heart of every TrueSource system is a Tristimulus color sensor. Tristimulus sensors, while electronic, actually "see" in a way that mimics the human eye's response to color. Even though every human sees color differently, there are well established base lines for normal color response. By taking live measurements and adjusting how each LED or group of LEDs is being driven, the problems of color shift during use are removed. Tristimulus values are referenced to the well established CIE 1931 2° observer color space. By referencing a true standard, TrueSource systems are inherently calibrated to each other. The problems of using only an initial calibration and predictive algorithms are not an issue with TrueSource systems.

Full Spectrum

TrueSource systems use several colors of primary emitters. At the minimum each TrueSource system will use 5 primary colors. These primaries are carefully chosen to minimize the valleys of the SED curve. When outputting 3200k "white", TrueSource systems have a CRI of 95+. With deep understanding of how to drive each individual LED, TrueSource is not locked into only using a fixed number of primary emitters. TrueSource is also flexible enough to utilize LEDs from several manufacturers at once. With this

discreet control, TrueSource systems can pick from the best available LEDs on the market.

Since all TrueSource enabled instruments are structured to provide a full spectral response, they have a very wide gamut. It is of course at the discretion of the lighting designer to choose the luminaire that provides the gamut they are looking to use, however TrueSource instruments give an unmatched flexibility from one source.

Interfacing with Color

TrueSource systems allow the designers and operators to ask for and interface with color in very specific ways not normally seen in current lighting equipment.

Instead of asking designers to describe color in a non-standardized way, ie. unknown RGB values, RGBW, RGBA, RGBCA, or seven discreet primaries. TrueSource instruments can be configured to respond directly to x,y coordinates on the CIE 1931 2° color space. An RGB mode that is based on the NTSC gamut, but slightly wider is available. The designer may also elect to use Hue and Saturation to describe the desired color. Each of these modes uses a dedicated dimmer channel that does not shift the color. Designers may also add a specific Correlated Color Temperature channel (CCT). The CCT channel takes over from the other color channels, not by adding white, but producing specific white points along the black body curve.

Optics

The TrueSource optical systems are truly the next generation of optical design. The beams are flat, and fully collimated. Without this careful collimation of the light, accurate live color metering would not be possible.

Each unit produces one shadow. A shadow that would be expected from a traditional source or natural sunlight. Of course diffusion can be added to soften or adjust the shadow, instead of starting from an unfamiliar shadow. Designers do not need to sacrifice tried and true angles for dimensionality and revelation of form.

The RevEAL (Revolutionary Entertainment and Architectural Lighting) instruments, manufactured by Prism Projection, are the first commercially available lighting instruments with the TrueSource system fully integrated. The RevEAL Color Wash, introduced in the Fall of 2009, has already received multiple industry awards. The RevEAL CW continues to see adoption into retail, entertainment, "architainment" and TV production venues. Available in the summer of 2010, new TrueSource enabled RevEAL CWs, will carry an unprecedented 5 year warranty that includes color consistency within a 4 step MacAdam Ellipse.

The summer of 2010 will also see the introduction of the next RevEAL instrument the "Studio Fresnel". Inspired by popular Fresnel style lighting fixtures, the newest RevEAL instrument will have all the color control and intuitive beam shaping abilities.

TrueSource at a Glance

Specifiable, Live Calibrated Color, with a collimated flat field.

- References international standards to describe color, CIE 1931 2° observer
- Uses multiple primary emitters to ensure full spectrum response
- Live color monitoring using Tristimulus sensor, sensing color similar to the human eye
- Wide gamut from one lighting instrument
- CRI above 95
- CCT Channel (as low as 1,800k up to 10,000k)
- Independent dimmer channel with no color shift
- A shadow that matches conventional sources
- 5 year color warranty