

Analysis of the proposed IEC “Color Illuminance” digital projector specification metric, using CIELAB gamut volume.

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Abstract

“Color Illuminance” is a proposed specification metric for IEC 61947-1 (Electronic projection – Measurement and documentation of key performance criteria – Part 1: Fixed resolution projectors) [Lang – www.lumita.com/color_illuminance.pdf]

The study evaluates the performance of the *color illuminance* metric by testing a sample of popular digital projectors in the business and education category. The RGB gamut surface was measured for two projector modes – “presentation” and “sRGB.” The CIELAB gamut volume was calculated and compared to the color illuminance ratio. The study confirms the utility of the color illuminance metric as a predictor of perceived color gamut and total projector performance.

Introduction

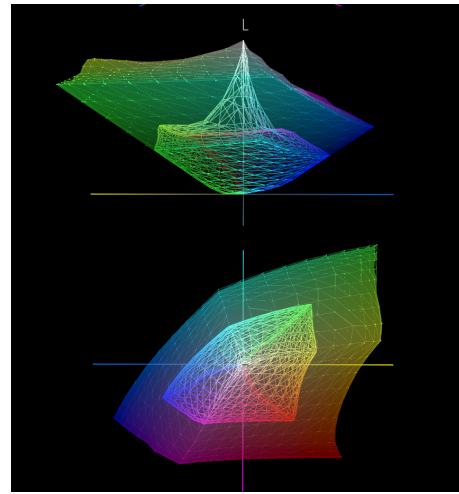
The IEC illuminance specification is a key performance metric for the comparison of digital projector light output. Consumers use this specification as a primary metric when making purchase decisions. Historically this metric has been clearly indicative of projector performance. Recently, new projector technologies have significantly distorted the metric and depreciated it’s utility as a fair comparison of total image brightness.

Some projector technology now has more than three primary colors and may include a white primary. In many of these projectors the output luminance of the maximum input signal for red, green and blue individually does not add up to the luminance of a white input signal, because of this discrepancy the IEC illuminance specification no longer represents the overall brightness of the projector in normal use. R,G,B not summing to white can also create a significantly distorted perception of color photographic images and a significant reduction in perceived gamut. [Heckamen, Fairchild - Journal of the SID 14/9, 2006]

Lumita has proposed the addition of a new metric “color illuminance” to the IEC standard. This new metric is designed to provide simple additional information so consumers can make informed purchase decisions based on both the white performance and the color performance of the projector.

Testing

In this study 9 digital projectors were acquired new. All the projectors were leading models (by sales) in the business projector market. The projectors were specified by their manufacturers at between 1600 and 2200 lumens. 5, 3LCD and 4, 1DLP models were selected. The projectors were burned in for 4 hours with a constantly variable random image. All tests were conducted in the projectors default “presentation mode” and again in the



Sample gamut of an RGBW 1DLP projector with a .32 color luminance ratio. Presentation Mode (wireframe) vs. sRGB mode (transparent solid.)

“sRGB” mode. In a controlled black room with a 1.0 gain screen and an image size of 1.1m², 602 color patches equally spaced on the RGB cube surface were displayed on the screen. Each patch was measured using a PR-670 spectroradiometer, three XYZ measurements were taken and averaged for each patch. Each projector was tested for white illuminance using the current IEC procedure. Each projector was also tested for “color illuminance” using the proposed procedure. The XYZ patch values were adapted to D50 using the measured white point of the projector and the Bradford method. The resulting XYZ values were transformed into CIELAB and a 3D solid was tessellated based on the ordered quads from the input RGB signal. The volume of the gamut in CIELAB was calculated by summing the volume of each 5 point prism created from a center point to all quads on the surface.

Results

In the default presentation mode, 5 of the projectors in the study (all 3LCD) demonstrated *color illuminance ratios* of 0.98 to 1.0 and gamut volumes from 640,556 to 774,231. 4 projectors (all 1DLP RGBW) had *color illuminance ratios* of 0.29 to 0.35 these projectors had gamut volumes between 181,079 and 261,627. 1 of the 1DLP projectors did not have an sRGB mode, of the 3 that did their *color illuminance ratios* went up to .59, .67 and 1.06. The gamut volumes went up with a high degree of correlation to 434,786 511,335 and 560,588 respectively.

Conclusion

The proposed *color illuminance* metric when combined with the current white illuminance provides a simple accurate description of projector performance. If photographic image reproduction and color gamut are not important a projector with a low ratio may be acceptable if color is important a high ratio should be the criteria.

