

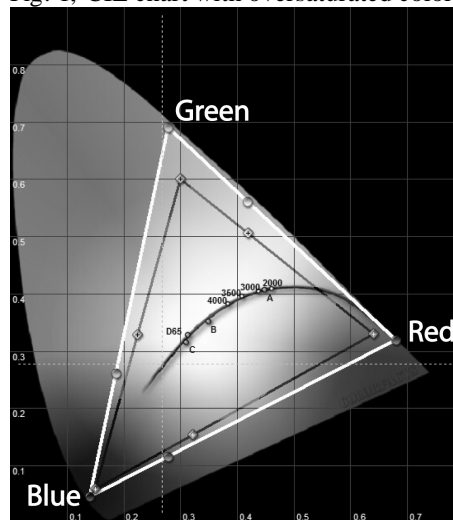
Lumagen Tech Tip 5

Primary Color Correction with Vision Series

Introduction

Some displays have oversaturated colors. During calibration, when you measure the primary color coordinates, you will find that the colors lie well outside the standard color triangle.

Fig. 1, CIE chart with oversaturated colors



The solution

The Lumagen Vision Series of processors can be used to correct the primaries on projectors where the color primaries are outside the REC709 color triangle. Note that the correction actually will be for the 75% color points as described below.

This is accomplished using the Lumagen color and color-offset controls. Note that these controls are designed to correct the primaries at the 75% color points using color bar patterns, rather than the 100% primary points. Since virtually all real-life sources, including animation, have colors that fall within the bounds of the 75% color points, this achieves the goal of correcting the color gamut for these displays/projectors -- for real material. It does not move the actual primaries by any significant degree, so test patterns of the primary points would show the primaries in approximately their original location.

From what we have seen at Lumagen, the displays and video processors claiming to have primary controls instead actually have Color, Hue and offset controls meant to calibrate the 75% percent points, like the Lumagen Vision series. So this approach is used by a number of companies for primary control. The upcoming Lumagen Radiance series will be adding a 100% primary control, in addition to the current 75% color and hue offset controls.

Calibration procedure

The AVIA standard-definition test DVD has the appropriate Blue, Red and Green color bar patterns. Soon HD patterns will be available as well. For this procedure you can use any test DVD or video generator that has accurate 75% color bar patterns. For SD patterns (480i or 480p) make sure that your video source outputs the color bars in the REC601 color space. For HD patterns (720p, 1080i or 1080p) make sure that your video source must output the color bars in the REC709 color space. Some video sources, such as certain up scaling DVD players and certain HTPCs, don't output all video resolutions in the correct color space.

It should be noted that SD patterns and HD patterns give the same results with the Lumagen for this calibration step. A SD (REC601) 75% color bar pattern which is processed by the REC601 color matrix in the Lumagen Vision yields the same values, for driving the display, as a HD (REC709) 75% color bar pattern which is processed by the REC709 color matrix in the Lumagen Vision.

Assuming the output resolution, and geometry, has been set up, the next step in calibration is to go through the display/projectors menu and select appropriate settings. For example, typically the display's "LOW" color temperature setting is closest to the correct D65 point. Also, it is almost always best to disable all those "advanced" features on the display as they generally degrade image quality. These are things such as the display's sharpness, edge-enhancement, dynamic-contrast, and even dynamic-iris. This last control is somewhat of a personal choice, but while a dynamic-iris improves test pattern contrast measurements, it can actually misbehave on real material, causing visible artifacts on the screen.

Next adjust the black level, and then the white level, using the Lumagen contrast test pattern (MENU → MISC → TPAT → PATS → OK, OK, ►, ►), and the black-level (brightness), and white-level (contrast) control in the display/projector. This initial black and white level setup should NOT use the Lumagen Black and Contrast controls. Reserve the Lumagen Black and Contrast controls for adjusting for differences between video sources.

The display's Gamma and color temperature should then be adjusted using the display's control for the 100 IRE point first, if available, and selecting a gamma curve from the displays menu, if available. Next the gamma and grayscale should be refined using the Lumagen's internal test patterns with the 2, 5, or 11-point parametric grayscale/gamma calibration, along with a color probe, as discussed elsewhere. Typically a gamma of 2.2 is used, but some experts like higher gamma values in the range for 2.4 for a more film-like experience.

The color primaries can be adjusted after you adjust the gray-scale/gamma. Using the AVIA disc from the main menu go to the advanced test pattern screen and then to the color pattern screen. Select the standard color bar test patterns. There are separate patterns for Blue, Red and Green. Calibrate using the Blue color bars and the Blue filter with the Lumagen Color and Hue controls (MENU → IN → CONFIG → COLR → COLR → [COLR, HUE]). Note that the Color and Hue controls adjust all three primary colors. Red and Green offsets to this base setting will be calibrated next. Note also that the Lumagen must be in user-mode, NOT service-mode.

For people using the component output from their DVD player to drive the Lumagen: Lumagen recommends calibrating the analog-to-digital (A2D) converter for the component input before proceeding. This is done by selecting the AVIA 100 IRE

(White) Window pattern and pressing MENU 0966 on the Lumagen, and then pressing OK. This will accurately calibrate the Lumagen input A2D to match the output of the DVD player for black-level, white-level, and the zero points for Chroma. One other thing to note is that different DVD player manufacturers use different maximum output-levels for Chroma (Pb and Pr). So, this calibration will not be as accurate using a component-input as it would be using a DVI or SDI input.

Set the black-level (also referred to as brightness) and the white-level (also referred to as contrast) using the Lumagen controls (MENU → IN → CONFIG → COLR → (BLCK, CONT) → [▼,▲] OK). This will adjust for the differences between your video sources. Select the needle pattern in AVIA (Advance AVIA → Video Test Patterns → Gray Scale & Levels → Black and White Levels → Needle Pulses) and follow the instructions on the AVIA disk.

Next adjust the red primary using the Red color bars with the red filter, and the Lumagen red offset controls (MENU → IN → CONFIG → COLR → COLR → [COLRED, HUERED]). Finally adjust the green primary using the green color bars, the green filter, and the green offset controls (MENU → IN → CONFIG → COLR → COLR → [COLGRN, HUEGRN]).

Often it is necessary to compromise when setting the Color, Hue and offsets. For each pattern there are two points of reference used when comparing using the filter. For example, for blue color bars, there are two places to compare. The first is matching two colors looking through the blue filter on the left hand side of the test pattern (per the AVIA disc instructions). The second is matching two colors on the right side of the test pattern. When adjusting using the left side the results will often be slightly different than when adjusting using the right side. So, the recommended way is to adjust using the left side and write down the resulting color setting. Then adjust using the right side. The two results should be averaged and that value entered into the Lumagen control. This process is repeated for Blue Hue, then for the Color and Hue offsets for the Red and Green color bars.

Once calibrated for one input, the results need to be copied to the other inputs and then saved to Lumagen memory. Use the copy color command (MENU → IN → COPY → COLR) to copy to either all memories, or just MEMA on all inputs. Copying only to all MEMA memories allows a before and after comparison to be done. This can demonstrate a dramatic improvement in color quality when the calibration is done correctly by first selecting MEMB (the before) and then MEMA (the after). When completed, use the SAVE command (MENU → SAVE → SAVE → OK, OK, OK) to make the calibration permanent.