Flanders Scientific Inc.

Perceptual Color Matching Using LightSpace CMS

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The Challenge:
Two monitors of different display technologies calibrated identically may still not perceptually color match as well as a viewer would want or expect. Certainly this phenomenon can be exacerbated by lower quality measuring devices, but even when using the best equipment and software available perceptual color differences between display technologies can remain. This is largely attributable to widely varying spectral distributions between these devices and the ability, or lack thereof, of currently available color matchings functions (CMFs) to accurately predict perceptual matches.

The CIE1931 2 degree standard observer CMF is the basis for practically all current professional video/display standards. However, alternate CMFs have been proposed and in some limited applications have actually been specifically utilized to offer better color matching (than CIE 1931) within the professional video industry. The most notable deployment of such an alternate CMF has been the recent wide-scale use of the Judd-Vos Modified CMF with OLED monitors. For most observers this alternate CMF has been quite effective at providing better color matching between OLEDs and other reference display technologies, but what can we do when no available alternate CMFs provide a perceptual match between any two displays in question? In such scenarios we can utilize LightSpace CMS to significantly narrow the perceptual color match gap between two displays.

Before continuing it is important to not overstate the metameric challenges at play in these scenarios. Two reasonably well calibrated monitors will typically look similar even if they are different technologies. Additionally, if separated into two viewing environments these displays will, for most observers, not require an alternate or custom CMF to provide an entirely satisfactory viewing experience as the human eye is very adaptable. Going through the extra steps to dial in closer perceptual matches is best suited to professional viewing environments where more than one display will occupy an observer's field of view.

The Solution:
1. Decide which of the two displays will serve as the primary reference (We will call this *Monitor A*). This reference device should be calibrated to a known standard.

2. Generate a flat white field test patch to both monitors. (90% white is recommended).

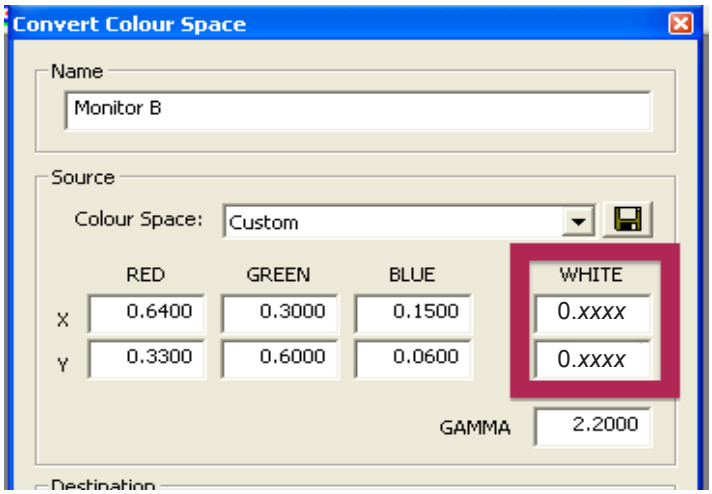
3. Provide a way for the color of the white field test patch to be adjusted ONLY on the secondary monitor (we will call this *Monitor B*). The best approach will vary depending on equipment in use, but can be as simple as adjusting RGB Gain controls on the unit.

4. Adjust Monitor B to perceptually match Monitor A on this one solid test patch.

5. After a perceptual match between the two is obtained use a color analyzer to measure the white point on Monitor B. Note this value for later use.

6. Profile Monitor B using LightSpace CMS. If you obtained your perceptual match by adjusting gain controls on Monitor B make sure to set those back to default before profiling.

7. Once your profile is complete create your 3D calibration LUT as you normally would in LightSpace CMS, with this one exception: instead of using the default target white point enter the x,y chromaticity values in the source window that you noted in step 5. This will generate a custom perceptual match 3D LUT for use on Monitor B.



Advantages:
The advantage of this approach is that your secondary monitor still receives a proper calibration based on actual measured data utilizing a weighted offset to ensure a perceptual match for the viewer. It is more effective than an after-the-fact white balance only adjustment that may have a poorly weighted influence on various colors or other highly variable negative impacts on overall calibration.

Limitations:
While effective at providing very good perceptual color matches between displays please note that this approach tackles primarily those differences attributable to differences in display spectral distribution. Other differences, such as native contrast ratio capabilities and screen size, may also have an impact on perceptual matching between displays.