Appendices

Appendix A: Specific mismatch to TV LEDs

With knowledge of the spectral response of our camera system, and the spectral power distribution of the TV units under test, we can come up with a theoretical spectral mismatch factor[10] for the test clip for a given TV, if all other sources of error are eliminated (see Experimental Error).

$$s_{rel}(\lambda) = \text{spectral response of camera}$$

$$V(\lambda) = \text{photopic curve}$$

$$S_C(\lambda) = \text{spectral power distribution of calibration source}$$

$$S_M(\lambda) = \text{spectral power distribution of light being measured}$$

$$F^*\left(S_M(\lambda)\right) = \frac{s_C}{s_M} = \frac{\dfrac{\int_{380nm}^{780nm} S_C(\lambda) * s_{rel}(\lambda)\mathrm{d}\lambda}{\int_{380nm}^{780nm} S_C(\lambda) * V(\lambda)\mathrm{d}\lambda}}{\dfrac{\int_{380nm}^{780nm} S_M(\lambda) * s_{rel}(\lambda)\mathrm{d}\lambda}{\int_{380nm}^{780nm} S_M(\lambda) * V(\lambda)\mathrm{d}\lambda}}$$

Calculated Spectral Mismatch Correction Factor Against Pure White Calibration

	Pure Red	Pure Green	Pure Blue	Pure White	SDR Clip Average	HDR Clip Average
LCD LED#1	1.012	1.000	1.001	1.0	1.0026	1.0025
LCD LED#2	1.003	0.999	0.998	1.0	1.0000	1.0000
QLED	1.002	0.998	1.011	1.0	1.0002	1.0005
OLED	1.013	0.998	1.040	1.0	1.0042	1.0048

The sharper wavelengths of the QLED and OLED lead to greater expected error, but in general, when we calibrate to white screens, the amount of error theoretically attributed to the filter match is negligible (at most 0.5%) compared to that which can come from simple experimental sources like camera placement, TV stability, etc. We don't calibrate against a calculated 'off-white screen' representative of the clip average, as factors like TV stability, electro-optical transfer functions, and differences in TV technology make the actual average light output hard to predict; using a white screen simplifies the process.

[10] Equations modified from ISO/CIE 19476: "Characterization of the performance of illuminance meters and luminance meters" 5.2.4: "Relative Luminous Responsivity and Spectral Mismatch Correction Factor"