Mastering with a Large LED Screen

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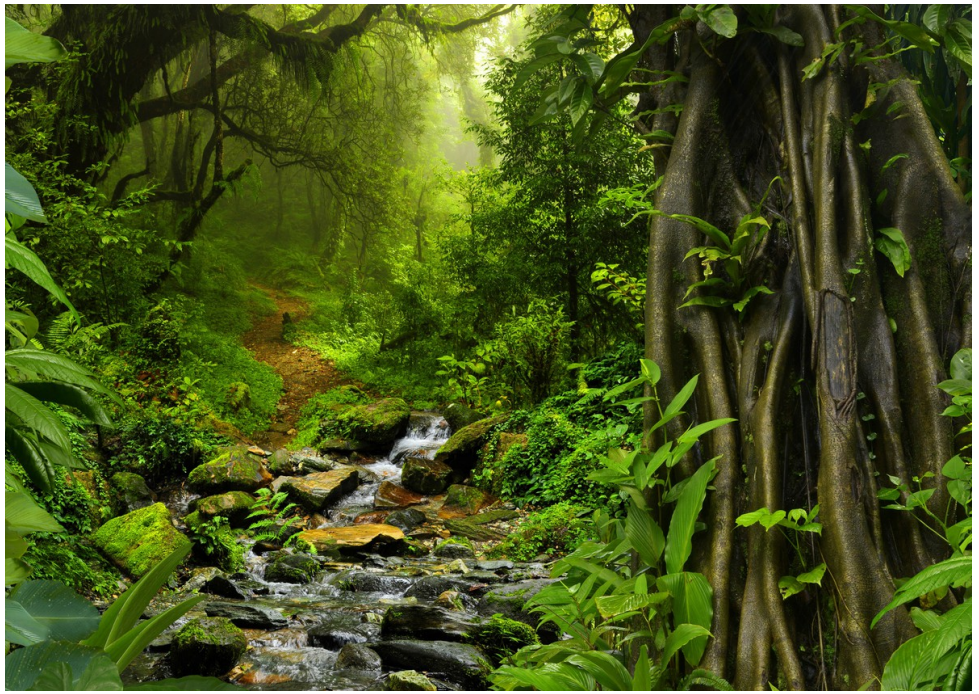
Why use a large LED screen (‘LED wall’) for mastering?

- Each deliverable in a typical finishing process requires a different display technology.
- A large display with capabilities that supersede those of other mastering displays holds promise for streamlining facility operation – ‘one screen to rule them all’.
- Creatives love seeing their content looking great!

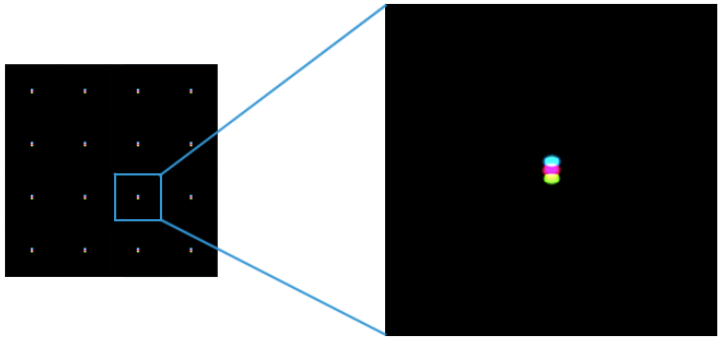


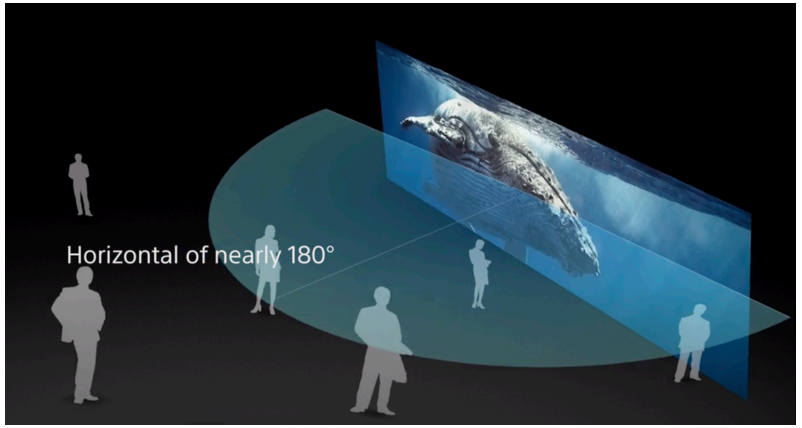
Micro-LED screen trial at Company 3 Santa Monica

- Sony “Crystal LED” screen installed summer 2019 in medium-sized mastering theatre.
- 17’4”x9’ for 4160x2160 pixels.
- Trialed for theatrical and home video mastering.
- Set up with P3DCI, P3D65, and ST2084 P3D65 (108nt and 1000nt peak) color spaces.

Artists liked…

- Very deep blacks (>20000:1 contrast in P3 mode).
- Contrast persists with ambient light (even with full house lights).
- No lens or screen aberrations (vignette, flare, hot-spot), so uniformly sharp and luminous across entire screen. Also very good color uniformity.
- Excellent viewing angle.
- Quickly switches between SDR and HDR, with possibility of simultaneous display.



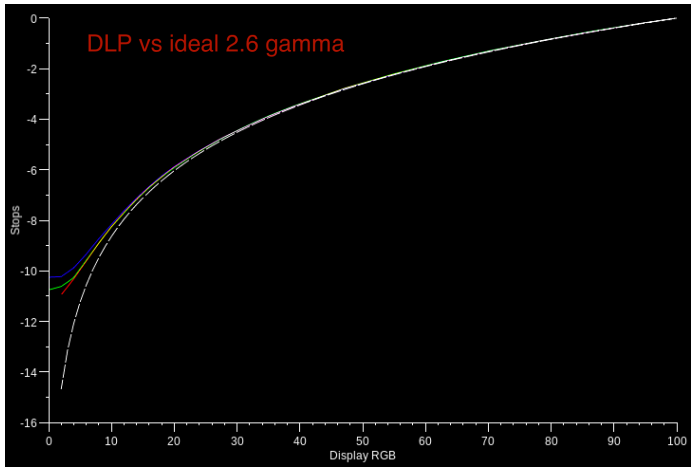


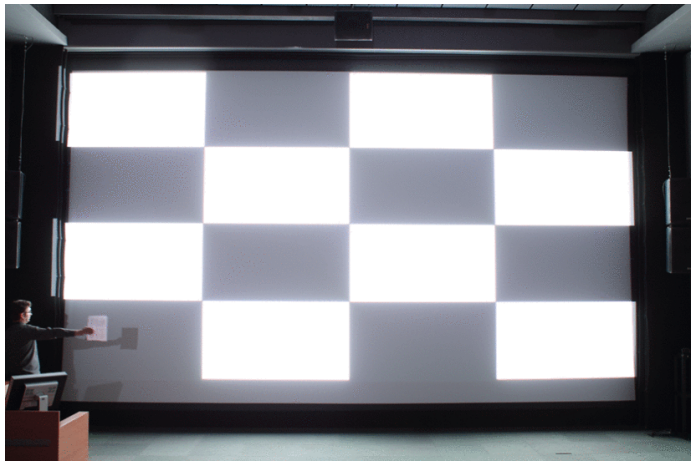
Artists are concerned about…

- For theatrical mastering: contrast behavior is not similar enough to typical appearance of distributed version (i.e. Xenon projected).
- Slight color cast towards yellow when compared to other calibrated displays.
- Color accuracy deteriorates at high luminance levels (>700nit).
- Unsure of appropriate ambient lighting conditions for home video mastering.

Mitigations: Contrast modelling of Xenon projection

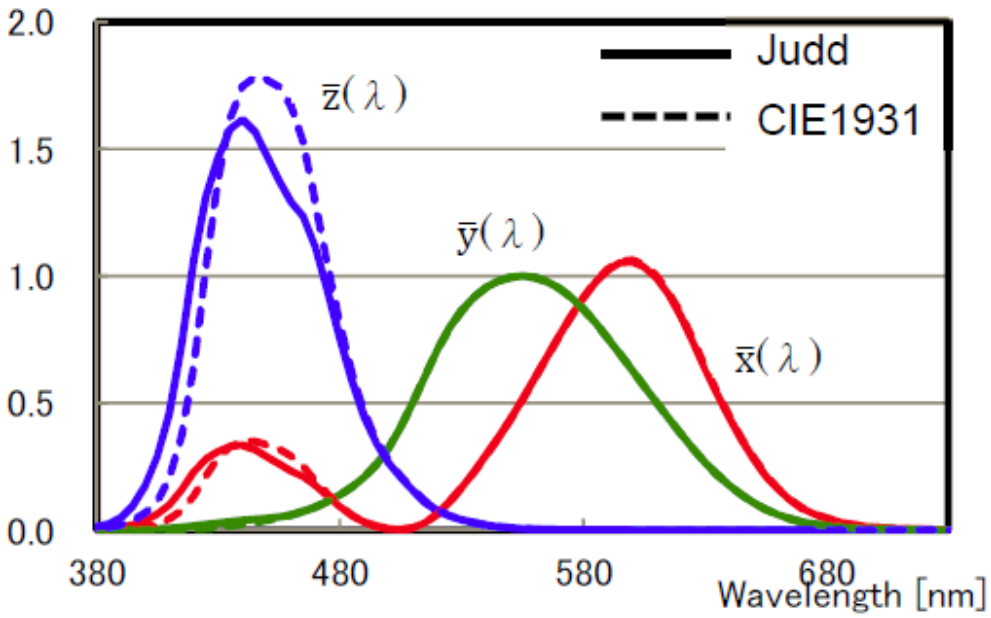
- A lookup-table can model a contrast profile…
- But cannot model flare and scatter (within projector, from port glass, theatre walls, etc.). Recall SMPTE 431 requires only 150:1 intra-frame contrast.
- Sony provided an OFX plugin to use in color corrector incorporating a spatial model of conventional projection.
  (from “Modeling of Achievable Contrast and Its Impact on HDR Projection in Commercial Cinema Environments” SMPTE Motion Imaging Journal, Volume: 125, Issue: 4, May-June 2016)
- But what are the ‘right’ parameters for the model?



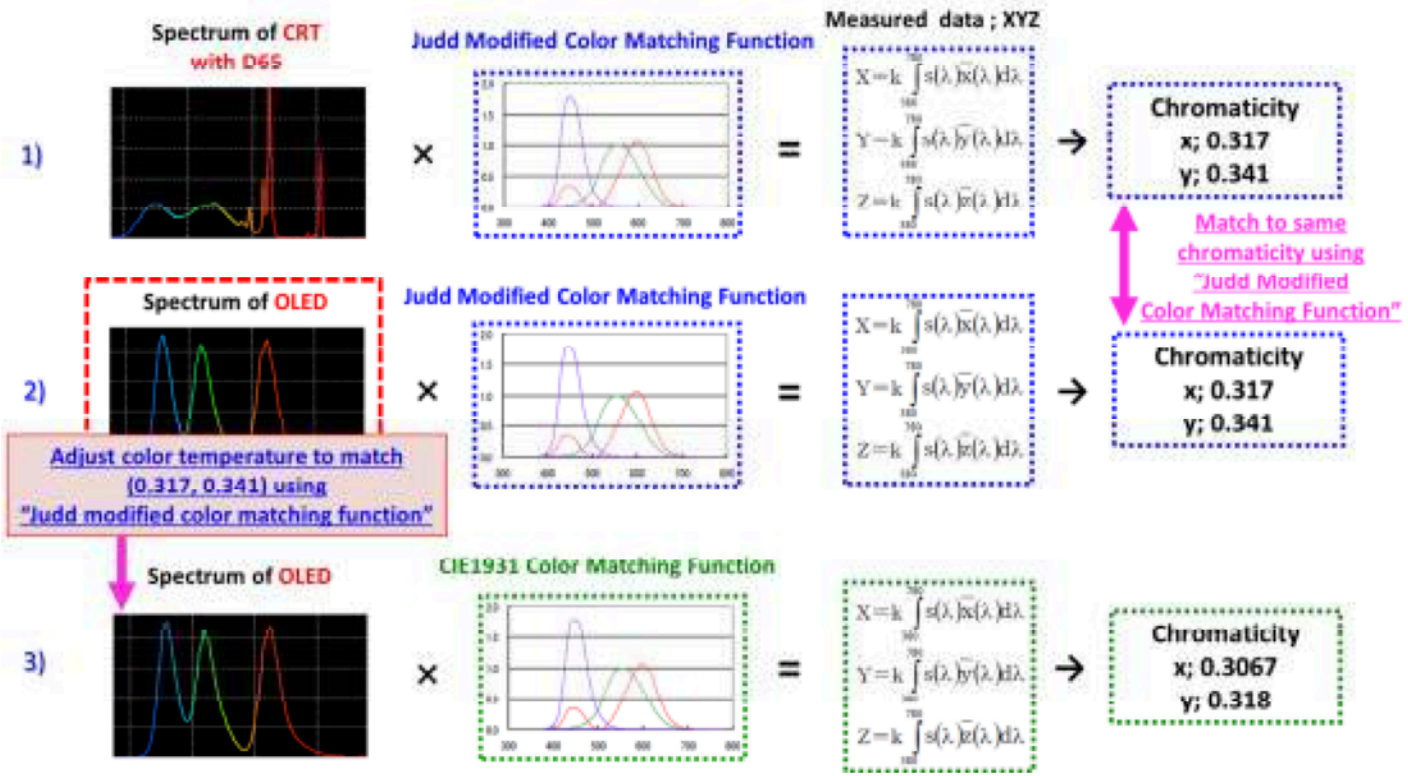


Mitigations: Color difference

- When two displays have very different primary spectra, standard calibration practices can still leave them visually different in color.
- Discrepancy can be attributed to the dated color vision model used in measuring devices (CIE 1931).
- A solution is to compute a display-specific offset to match a CIE 1931 measurement to one with a modern color model – the ‘Judd offset’.



Computation of the "Judd offset" – OLED to match CRT



An operational calibration offset when using CIE 1931 measuring devices with OLED monitors, based on equivalence under Judd-Vos 1978 color vision model.

From Sony white paper: "Color Matching between OLED and CRT", February 2013.

Subsequently included in SMPTE RP 2080-2 .

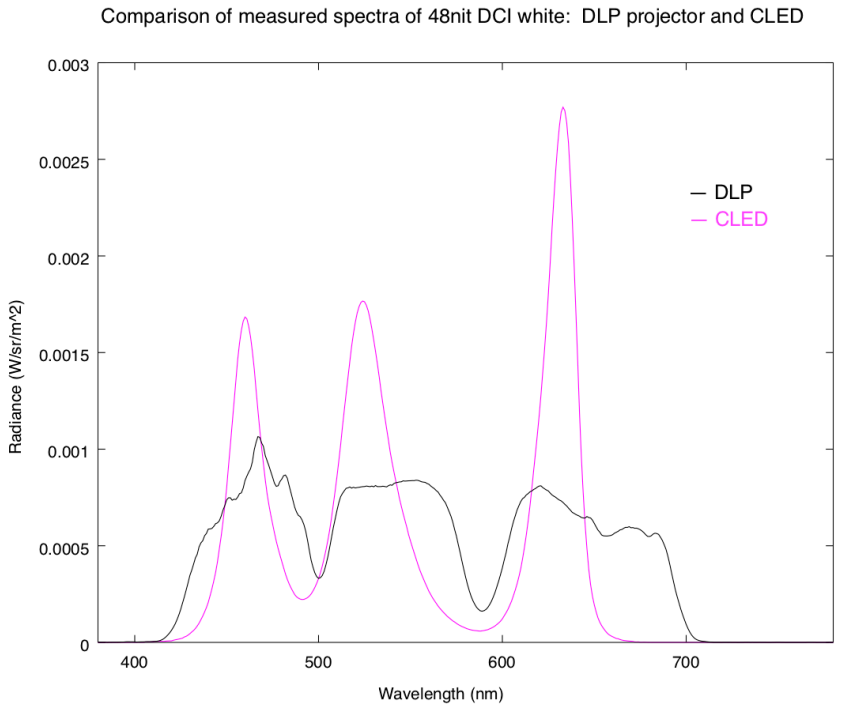
"Judd offsets" for CLED calibration

- We computed offsets for matching a CLED to a Xenon (DLP) projector and to an OLED (Judd calibrated).

$\Delta x_{\text{DLP}} = -0.003$
$\Delta y_{\text{DLP}} = -0.007$

$\Delta x_{\text{OLED}} = -0.008$
$\Delta y_{\text{OLED}} = -0.014$

- Consistent with observations.
- Larger than projector tolerance ($|\Delta_{xy}| < 0.002$).
- Correction can be incorporated into the color corrector (like the OFX plugin).



Technical and operational observations

- Installation substantial – requires front-wall space and a strong floor.
- Very color-stable – less need for regular calibration.
- Reliability uncertain – individual panels can fail (but can be replaced).
- Still prohibitively expensive.

In conclusion

- We trialed a 4k Sony ’CLED’ display and found it to have exceptional characteristics for accurate representation of both SDR and HDR content.
- We have trialed an OFX plugin for contrast matching Xenon projection, and we have computed “Judd offsets” for color matching to Xenon projection and to OLED display.
- SMPTE 431 may need revising to establish a possible *maximum* bound on contrast in order for typical projection modelling on HDR screens. And SMPTE 2080 may need revising to take into account large display sizes for home video.
- Our artists and engineers are very excited about this technology and believe its versatility can transform the mastering process.