

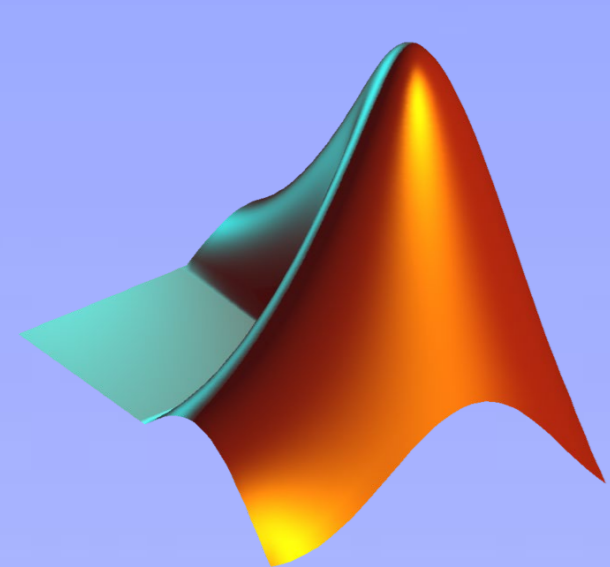
## Color calibration in virtual reality for Unity and Unreal



HTC Vive Pro Eye



### Display Measurements setup



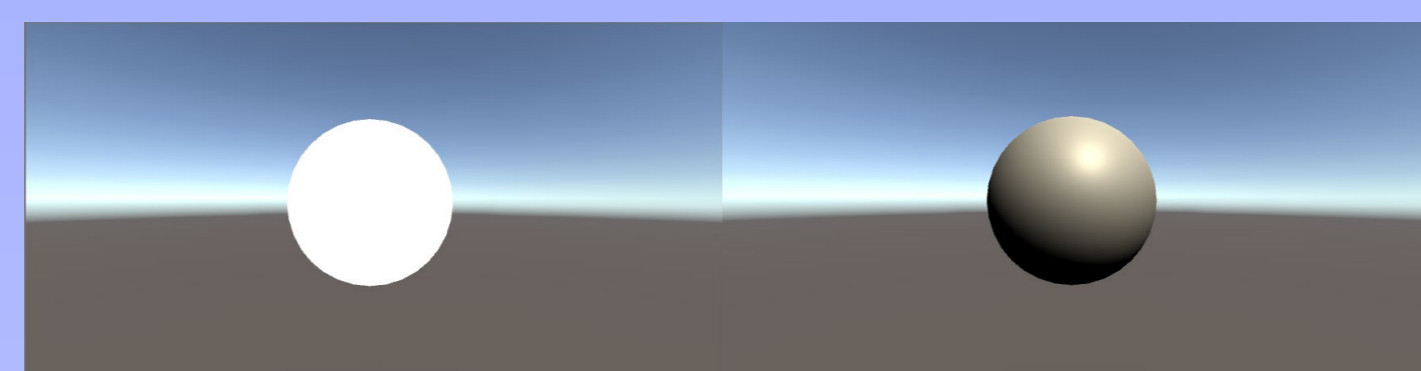
Psychtoolbox 3



Unity

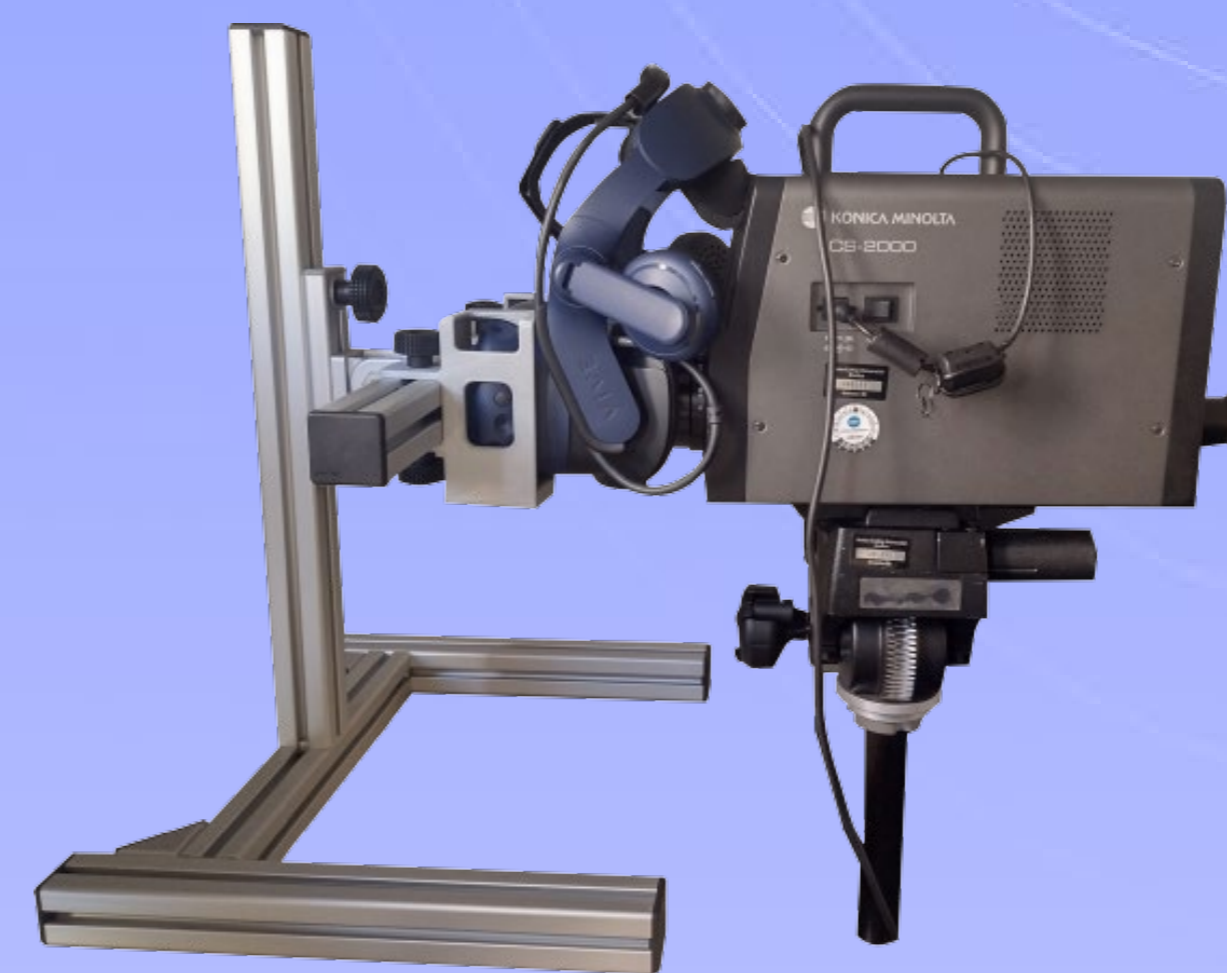


UNREAL ENGINE

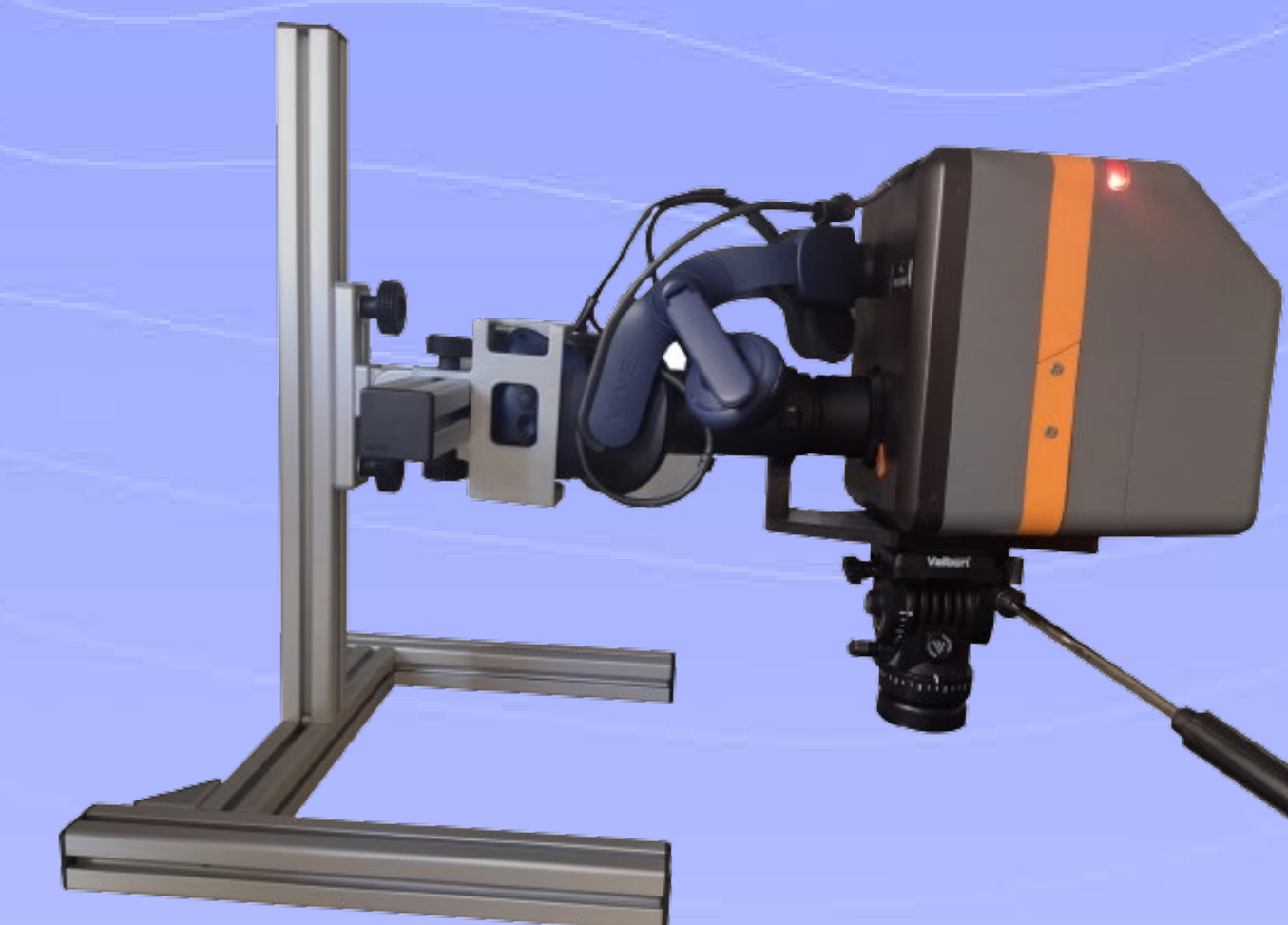


Unlit

Standard



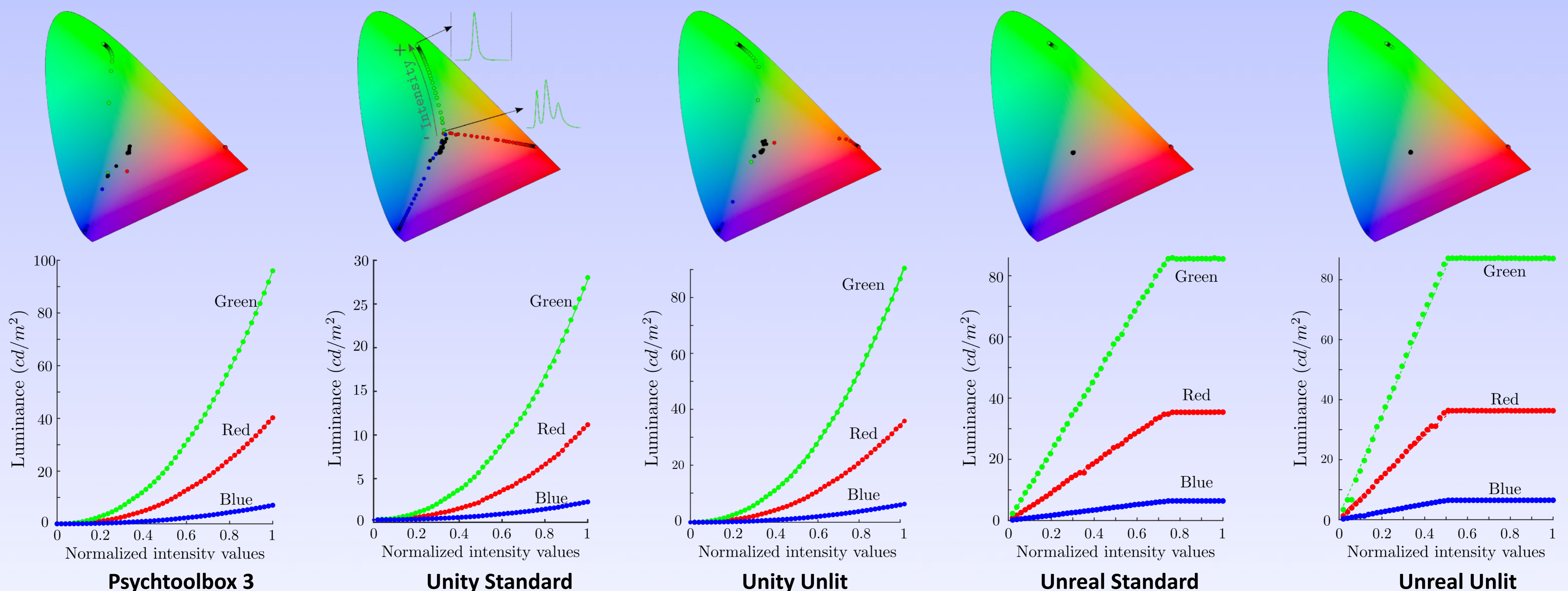
Spectroradiometer Konica Minolta CS2000-A. Used for chromaticity, spectra and colorimetric behavior.



I29 Imaging Colorimeter. Used for luminance and uniformity.

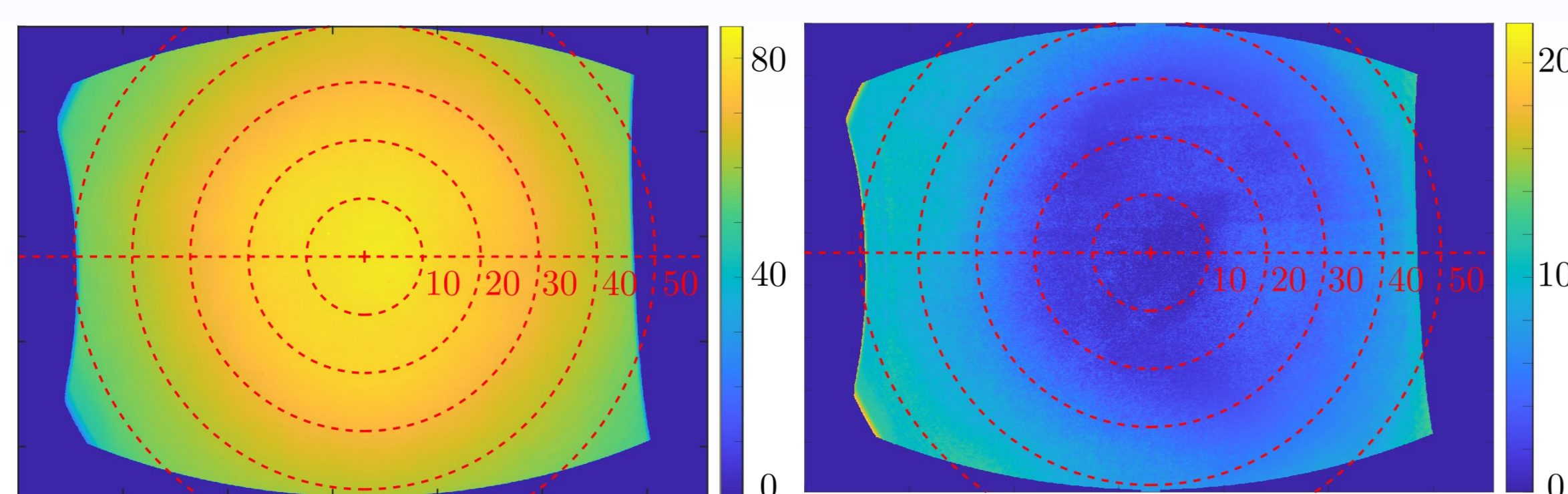
A methodology was proposed to carry out a color calibration customized to the type of material or graphics engine used for more accurate and realistic color representation in VR.

### Colorimetric behavior



On the top: Chromaticity of different materials and graphic engines. On the bottom: Relationship between luminance and normalized intensity values for each channel (Red, Green and Blue). Different graphics engines show significantly different behaviors.

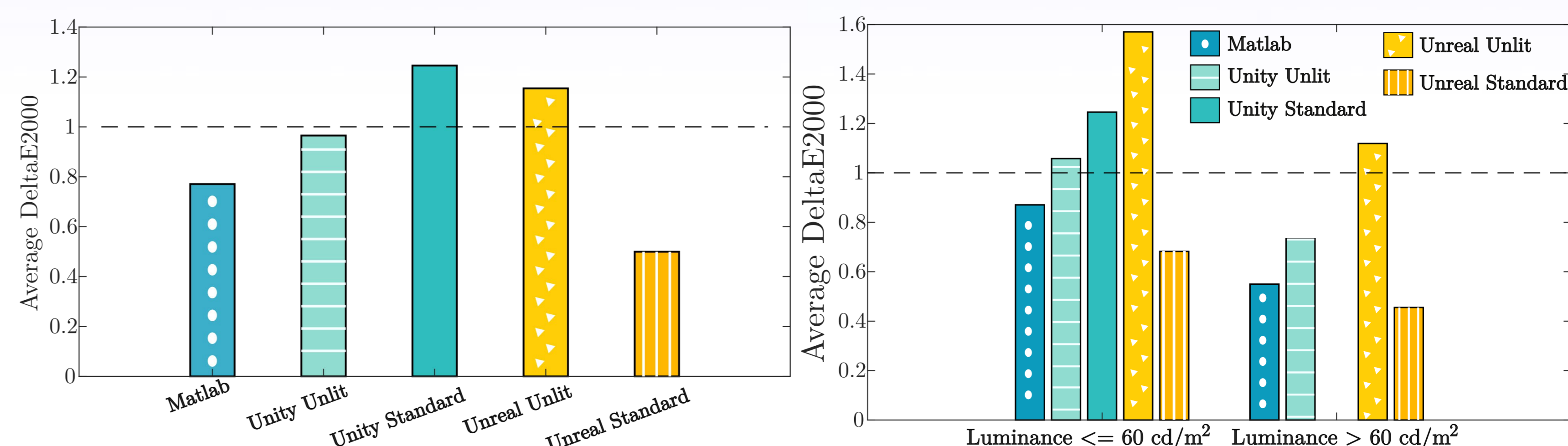
### Luminance and Uniformity



	10°	20°	30°	40°	50°
Luminance (cd/m <sup>2</sup> )	80.22	77.90	73.22	66.51	59.89
Chromaticity (error)	1.37	2.25	3.73	6.14	8.62

Between the center of the display and the region at 50 degrees, luminance drops 36% less than the central region. In addition, the chromaticity error is 6 times higher in the periphery of the display than in the center.

### Validation of Calibration



In general, the calibration validation error is lower in Unreal than in Unity. In all cases, DeltaE2000 error values are close to or below 1.

The highest error values are produced when the luminance values are at low values (<60 cd/m<sup>2</sup>).

### Acknowledgments

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