

LED 백라이트를 이용한 LCD 모니터의 색측정

Colorimetry of a LCD monitor with a LED backlight

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LED backlight units are emerging due to the demand of pure light source for improving the image quality of LCDs.⁽¹⁾ The advantages of LED backlight units were recently reported.⁽²⁻³⁾ Specially, the color-gamut expansion and color-shift reduction of a LCD with a LED backlight were theoretically estimated.⁽⁴⁾ Associated with these, we evaluated color characteristics of a LCD monitor with a LED backlight by using a spectroradiometer which is traceable to both KRISS illuminance responsivity scale and NIST spectral irradiance scale. The chromaticity coordinate and luminance of RGB primaries of two monitors, a LCD monitor with a LED backlight and a LCD monitor with a CCFL backlight, were determined and compared. We referred to Flat Panel Display Measurements (FPDM) standard for evaluation of the monitors.⁽⁵⁾

First, chromaticity coordinate, spectral distribution, and luminance of full screen Red, Green, Blue (RGB) primaries were measured at the center of screen. In Fig.1 is plotted color gamut based on the measured $u'v'$ coordinates of RGB primaries. We found that the LCD with LED has 145 % and 115 % gamut of the LCD with CCFL and National Television System Committee (NTSC) primaries, respectively. Also, the spectral distributions of RGB primaries were measured. The spectra of RGB primaries of LCD with LED show symmetrical peaks.(Fig.2(a)) On the other hand, the RGB primaries of the LCD with CCFL has broad and asymmetric spectral distributions.(Fig.2(b)) Also, the dominant peak of each primary was found to appear at the spectra of other primaries, which came from the nonuniformity of spectral distribution of CCFL. Luminance that owns achromatic information was determined as 70.2 cd/m², 170.4 cd/m², 26.9 cd/m² for R, G, B primaries of the LCD with LED backlight and 84.9 cd/m², 240.0 cd/m², 31.6 cd/m² for those of the LCD with CCFL backlight. Second, chromaticity coordinate and luminance were measured at five different positions for the evaluation of positional uniformity. The $u'v'$ chromaticity coordinates and luminance were measured at five points according to the recommendation of FPDM standard. Nonuniformity of luminance, $L_{\text{nonuniformity}} (=1-L_{\text{min}}/L_{\text{max}})$, is determined from maximum luminance L_{max} and minimum luminance L_{min} . The LCD with the LED shows minimum 1/4 times smaller color difference compared with the LCD with CCFL, while the luminance nonuniformity of the LCD with LED is up to 1.6 times larger than that of the LCD with CCFL. Third, chromaticity coordinate and luminance are measured as a function of a viewing angle in a range of -85° to 85° with 5° interval. In Fig.3 (a) and (b) are plotted $u'v'$ values at the viewing angle of -85° to 85° of RGB primaries of two monitors with the LED and the CCFL backlights, respectively. The maximum color difference occurs

at the viewing angles with magnitude of 85° . The LCD with LED was found to be maximum two times efficient in color shift occurred by a viewing angle performance. Also, luminance of RGB primaries is measured at the viewing angles in a range of -85° to 85° with 5° interval.

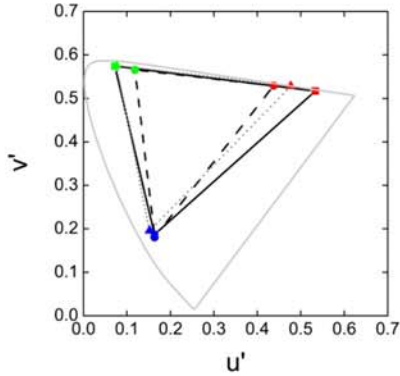


Fig.1 Color gamut of LCD monitors on the CIE 1976 UCS diagram. Solid, dashed, and grey dotted lines correspond to the gamut of LCDs monitors with a LED backlight, a CCFL backlight, and NTSC primaries, respectively.

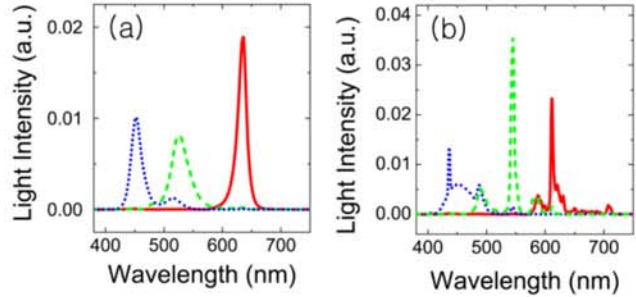


Fig.2 Spectra of RGB primaries of LCD monitors with (a) a LED backlight and (b) a CCFL backlight.

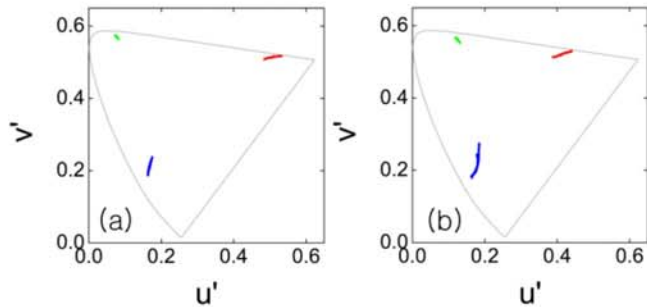


Fig.3 Color shift of RGB primaries of LCDs (a) with a LED backlight and (b) with a CCFL backlight measured at the viewing angle of 0° to 85° .

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