PWDAS-15

DETERMINATION OF LED LUMINANCE AND RADIANCE FROM EFFECTIVE INTENSITY

Erkki Ikonen[1,2], Tuomas Poikonen[1], P. Kärhä[1] and Pasi Manninen[1]

[1]Metrology Research Institute, Helsinki University of Technology (TKK), Finland
[2]Centre for Metrology and Accreditation (MIKES), Espoo, Finland

An important need to measure LED luminance or radiance comes from photo-biological safety issues, since the image of an LED is projected to human retina in case of direct viewing. For the safety purposes, it seems sufficient to measure the average luminance or average radiance on the radiating surface of the LED source. We have earlier developed a method which can be used to determine the LED illuminance $E_v(d)$ by using equation[1]

$$E_v(d) = \frac{I_{v,eff}}{(d+\Delta d)^2 + r_0^2 + r'^2_0}, \qquad (1)$$

where $I_{v,eff}$ is the effective luminous intensity of the LED, Δd is the fitted distance offset, r_0 is the radius of the circular LED source, and r_0' is the radius of the active area of the photometer. The model of Eq. (1) has the favorable feature that $I_{v,eff}$ is constant over a substantial range of distances d. A similar relation can be obtained between broadband or spectral irradiance and effective radiant intensity. With known values of $I_{v,eff}$ and r_0 it is possible to determine the average LED luminance by $L_{v,eff} = I_{v,eff}/A$, where $A = \pi r_0^2$ is the area of the radiating surface. The purpose of this work is to find out how well the average luminance determined from $I_{v,eff}$ matches with the luminance values measured by a luminance meter. The luminance meter was also used to determine r_0 in such a way that it corresponds to the radius at which the measured luminance reduces to the half of the peak value. Table 1 shows preliminary measurement results for two 5-mm LEDs at the distance between 300 and 800 mm.

Table 1. Average LED luminances determined by different methods. For the luminance meter data, the values are averaged within a circle of source radius r_0

				Average luminance / Mcd/m^2	
LED	Color	Beam width (FWHM)	Source radius / mm	Luminance meter	From effective intensity
TLPGE183P	green	6°	2,4	0,13	0,19
E1L51-YC1A	cyan	8°	2,3	0,53	0,66

1 E. Ikonen, P. Manninen, and P. Kärhä, *Modeling distance dependence of LED illuminance*, Light & Engineering 15, 57-61 (2007).

For these preliminary tests, the average luminance determined from $I_{v,eff}$ is 20% to 50% larger than the luminance determined by the luminance meter. The results suggest that the model of Eq. (1) can be used to obtain a realistic upper limit for the LED luminance when a suitable method, such as a digital camera, is available for approximate determination of the area of the radiating surface.