

PWDAS-23

MULTI-COLOR LED-BASED INTEGRATING SPHERE SOURCE FOR MEASUREMENT OF SPECTRAL LUMINOUS EFFICIENCY FUNCTION OF HUMAN EYES

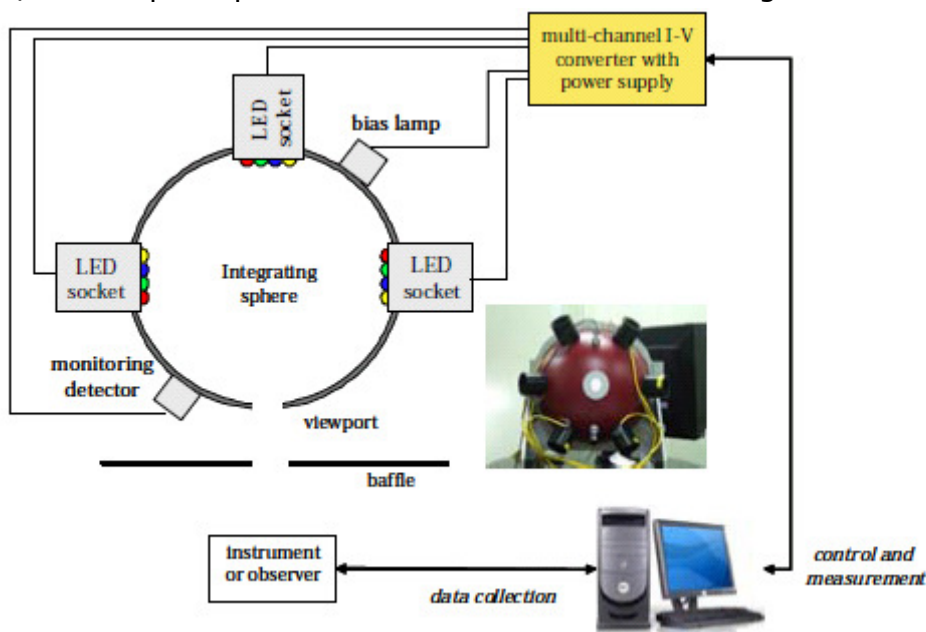
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We present a LED-based integrating sphere (IS) source and its experimental application for measurement of spectral luminous efficiency function of human eyes.

Figure 1 shows the schematic setup of the IS source. Seven LED modules, a tungsten-halogen lamp for bias light, and a monitoring detector are attached on an integrating sphere with a diameter of 30 cm. Each LED module contains 18 LED lamps of different colors, which can be independently controlled using a PXI module via a multichannel I-V converter. We configured the LEDs so that each channel of the I-V converter is connected to a group of LEDs with the same wavelength. Figure 2 shows the spectra of each color-channel measured at the maximum current for LEDs using a spectro-radiometer. The IS source can be operated either as a color-selectable source (single-channel operation) or as a color mixer (multi-channel operation).

We propose to apply this LED-based IS source to measure the luminous efficiency function $V(\lambda)$ of human eyes based on hetero-chromatic flicker method. Fig. 3 shows the preliminary result demonstrating the feasibility for this application. In the experiment, the test LEDs at a selected color are flickered by modulating at a rate of 10 Hz. The non-modulated bias light with correlated color temperature of 2557 K and luminance of 4.8 cd/m^2 is superimposed on the modulated test LED light in the IS source in order to provide



a background illumination condition for photopic vision. The test person observes the viewport of the IS source with a 2° view-angle and adjusts the level of the flicking test LED light to find the threshold level for perception. The threshold level is then measured by a spectro-radiometer in radiance ($\text{W/m}^2 \cdot \text{sr}$). As a result, we determine a quantity of eyes corresponding to noise-

Figure 1. Schematic setup of the multi-color LED-based IS source.

equivalent power (NEP) of detectors at the selected wavelength. Repeated measurements at different wavelengths provide information on spectral luminous efficiency of the test person at the specific condition as shown in Fig. 3.

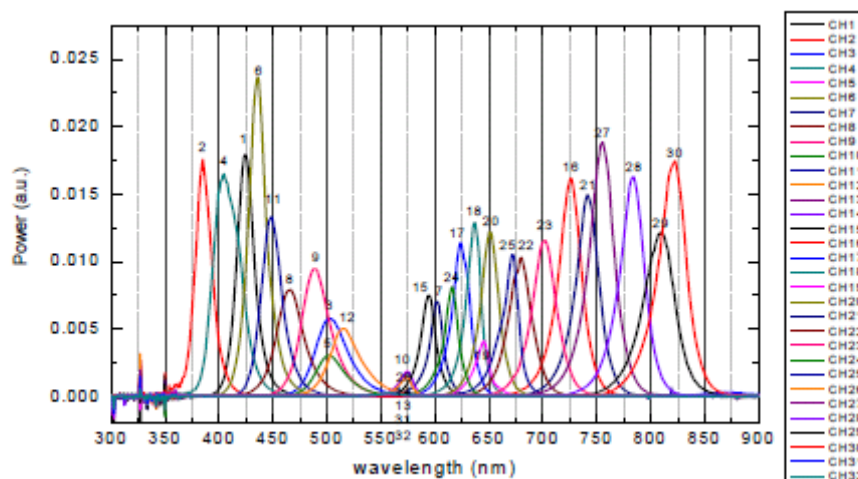


Figure 2. Measured emission spectra of the IS source for each LED.

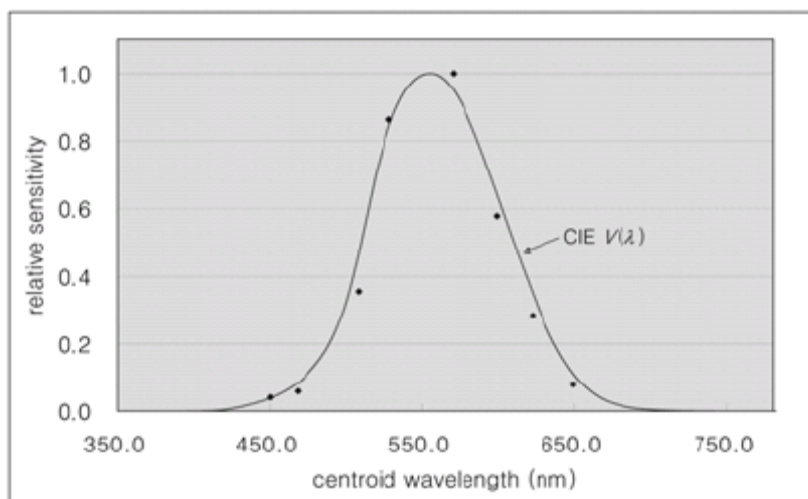


Figure 3. Measured spectral luminous efficiency function of a test person (dots).