CHARACTERIZATION OF A PHOTOPIC-SCOTOPIC LUMINANCE METER FOR MEASUREMENTS IN THE MESOPIC REGION

Maksim Shpak[2], Petri Kärhä[1], Geiland Porrovecchio[3], Marek Smid[3], Erkki Ikonen[2]

1. Aalto University, Metrology Research Institute, Espoo, Finland.
2. Centre for Metrology and Accreditation (MIKES), Espoo, Finland.
3. Ceský Metrologický Institut, Pgrague, Czech Republic.

We present a photopic-scotopic luminance meter characterized for measurements in the mesopic region. Recommended system for mesopic photometry was published by CIE in 2010, and according to this system, the mesopic luminous efficiency function is a linear combination of the photopic and scotopic luminous efficiency functions in the range of 0.005–5 cd/m2. The ratio in which the functions are combined is determined by the adaptation condition of the observer.

Our instrument is a spot luminance meter with two detection channels for the scotopic and photopic detection. The main parts of the instrument are an objective lens, a field stop defining the field of view, a beamsplitter and two detection channels with a photopic and a scotopic filtering respectively. The signal is measured with silicon photodiodes and a custom-built dual channel switched integrator amplifier. System control and data collection are performed with a portable computer, where luminances from the two channels are combined in an appropriate ratio to obtain a mesopic value.

The instrument is characterized for the relative spectral responsivity of both channels using a radiance source consisting of an integrating sphere with monochromatic light or with a set of 30 individually selectable LEDs with known spectra. The linearity characterization is challenging as the signal levels required for the scotopic end of the range are extremely low. The linearity is characterized with an integrating sphere as the radiance source, by varying the amount of irradiance on the input port of the sphere. This is performed by changing the distance between the incandescent source and the sphere. This preserves the relative spectral distribution of the signal. Power ratios are obtained from the inverse square law and from the monitor detector attached to the sphere.

The results for the spectral responsivities, corresponding spectral matching quality factors $f'1$ and linearity will be presented at the conference. The work leading to this study was partly funded by the EMRP ENG05 Project "Metrology for Solid State Lighting." The EMRP (European Metrology Research Programme) is jointly funded by the EMRP participating countries within EURAMET and the European Union.