PWSOI-17

THE TRI-FIELD GONIOPHOTOMETER

Jiangen Pan[1], Qian Li[1] and Peter Marx[2]

[1]*EVERFINE PHOTO-E-INFO CO., LTD., Hangzhou, China*
[2]*TFH(University of Applied Sciences), Berlin, Germany*

1. Introduction

Goniophotometers are more and more important in optical metrology for light sources, especially for LED products which require for absolute measurement[1]. The absolute measurements ask even higher requirements.

For goniophotometers, the stability of test light source is very important. The types with facility for turning the light source are not suitable for discharge lamps[2]. And as LED products are sensitivity to temperature, goniophotometers with mirror on optical axis[2] are also not suitable, because the moving of light sources in large space will introduce considerable temperature alteration.

The photometer accuracy, stray light and angle accuracy are also important for the goniophotometry accuracy. Besides, the dark room shall large to reduce stray light, however, it is always limited by practical conditions[3], thus the optimization utilization of the space in dark room is required.

2. Structure and measurement of the tri-field goniophotometer

A novel Tri-field Goniophotometer is developed by EVERFINE for both relative and absolute photometry.

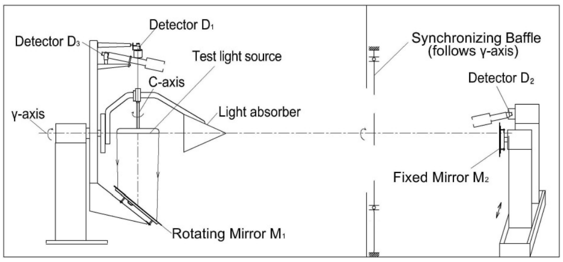

Fig.1 Structure sketch of the Tri-field Goniophotometer

As fig.1 shows, there are 3 detectors and 2 mirrors in the system, Detector D_2 and Mirror M_2 are switchable.

2.1 Near field measurement

Detector D_1 receives test light directly from the light source when Mirror M_1&M_2 are covered, as shown in fig.2. The measurement distance can be set to 2m-3m according to the size of the dark room.

Detector D_1 can be a photometer head, a spectroradiometer or an imaging luminance meter.

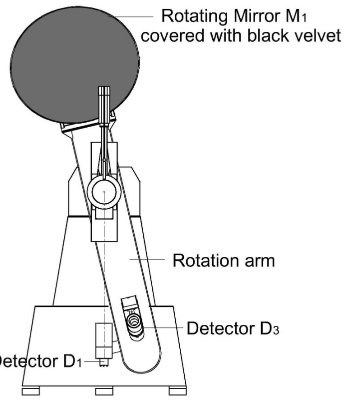

Fig.2: Sketch of near field measurement

2.1.1 Absolute luminous flux measurement

By Detector D_1 with cosine-correction, the system act as a compact goniophotometer which are suited best for the luminous flux measurement[4]. The luminous flux is derived from the illuminance distribution. It is valid for sources of any size, and the solution is applied to set up "lumen" unit in many national metrology institutes[5].

2.1.2 Luminous intensity measurement

Detector D_1 is also perfect to measure the luminous intensity of compact light sources[4] like LED lamps, signal lights, and etc.

2.2 Quasi-far field measurement

As fig.3 shows, when being switched to work, Detector D_2 and the synchronizing baffle rotate synchronously with Mirror M_1 which reflects test light to Detector D_2 in normal direction, the measurement distance is around 15m. Detector D_2 is suitable to measure the luminous intensity of large size sources with wide beam angles, such as indoor lights, road lights and so on.

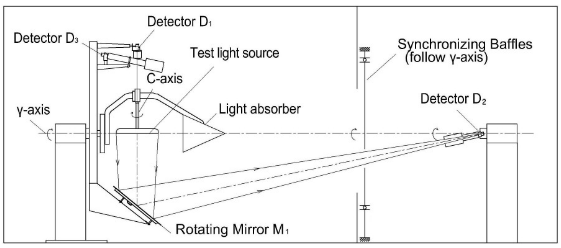

Fig.3 Sketch of quasi-far field measurement

2.3 Far field measurement

As shown in fig.4, Detector D_3 receives light from the test light source after two reflections respectively by Mirrors M_1&M_2.

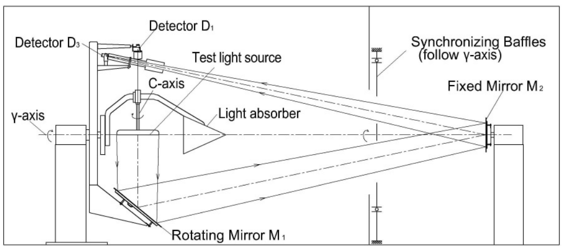

Fig.4 Sketch of far field measurement

Detector D_3 can be applied for intensity measurement of large size sources with narrow angle, e.g. floodlights. The measurement distance is generally 30m while the required length of dark room is near half of the measurement distance, and the synchronizing baffle only let the test light pass through to reject stray light, therefore the dark room space is optimized.

3. Uncertainty analysis of the measurements

In the Tri-field Goniophotometer, the tested light source can be stably burning at the rotation center of the goniophtometer in its required attitude; the synchronizing baffle rejects stray light effectively; and the angle accuracy is as high as 0.05°. These ensure the accuracy of absolute measurement.

The detectors are calibrated by standard luminous intensity lamps whose uncertainty are 0.7% (K=3). The combined uncertainty for the calibration of Detector D_1 can be 0.53 (K=2), and 0.64% and 0.68% (K=2) for D_2 and D_3.

The luminous flux measured by Detector D_1 can correct the absolute value of photometric quantities obtained by Detector D_2 and D_3 for large sized light sources to reduce the influence of the reflectance non-uniformity of mirrors on the fact that luminous flux is independent on the measuring distance.

The measurement uncertainties of luminous flux and intensity distribution of typical lamps and luminaries, e.g. LED products, FLs, HIDs, indoor lights, outdoor lights and floodlights, are discussed in details in the full paper.

Acknowledgement

This work is supported by the National Hi-Tech Research and Development Program (863) of China under No. 2007AA03A181.

Dr. Georg Sauter from PTB Germany is also acknowledged for his very helpful discussions about the goniophotometry in recent years.

REFERENCES

[1] IES LM-79-2008 Electrical and Photometric Measurements of Solid-State Lighting Products;

[2]CIE 70-1987 Measurement of Absolute Luminous Intensity Distributions;

[3] Peter Marx, New Goniophotometers for Lighting Engineering Laboratories, Publication No. 133, CIE-Session Warsaw 1999, Proc. Volume-Part 1, 189 -192

[4] Georg Sauter, Goniophotometry: New Challenges and Novel Solutions, Proc. of 2008 Expert Symposium on Advances in Photometry and Colorimetry

[5]CIE 89-1989 Measurement of luminous flux.