Consultative Committee for Photometry and Radiometry (CCPR)

24th Meeting (19 - 20 September 2019)

Questionnaire on activities in radiometry and photometry

Reply from: NMIJ (National Metrology Institute of Japan)

Delegate: Hiroshi Shitomi

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1. Summarize the progress in your laboratory in realizing top-level standards of:

   (a) broad-band radiometric quantities :
   - N/A

   (b) spectral radiometric quantities :
   - Spectral regular transmittance from 300 nm to 1000 nm.
   - Total spectral radiant flux in 2π geometry from 380 nm to 780 nm.

   (c) photometric quantities :
   - N/A

2. What other work has taken place in your laboratory in scientific or technological areas relevant to the CCPR?

   - Development of novel blackbody sheets based on microtextured PDMS elastomer that has an extremely low reflectance of < 0.001 at entire mid-IR. Further extension of spectral range of near-perfect absorption from UV to mid-IR by pre-addition of carbon black.
   - Development of a standard LED optimized for luminous flux and total spectral radiant flux measurement in 2π geometry with improved spectra properties that almost covers full visible wavelength range.
   - UV-LED radiometry for ultra near-field condition with irradiation distance of 10 mm.
   - Survey of accuracy of commercial UV radiometers using standard UV-LEDs.
   - Development of an LED-based compact transfer standard source for luminance measurement.
   - Development of an LED-based spectrally tunable source with high dynamic range for precise lighting booth application for photometry and colorimetry.

- Beam profiler calibration for quality laser manufacturing at wavelength of 1 µm by means of laser beam diameter and pixel to pixel-response non-uniformity.
- New stabilization technique of high-power laser by means of evanescent field photonics.
- Optical fiber length calibration for OTDRs at wavelength of 1.3 µm.
- Determination of detection efficiency for single photon detectors at wavelength range from 400 nm to 1000 nm
- Experimental and theoretical evaluation of non-linearity behavior of Si-PDs based on the flux addition method with the following considerations; 1) analysis of wavelength dependence, 2) nonlinearity suppression for an inverse-layer-type silicon photodiode and 3) comparison between over- and under-filled illuminations.
- Accurate radiometry for RGB-based laser display by means of non-linearity measurement of CCD-based array-specroradiometers.
- Development of novel $BaSO_4$ coating for an integrating sphere processed with thermal spraying technique that has excellent mechanical strength and high durability against UV exposure.
- Error analysis in terms of field-of-view and measurement distance conditions for blue light hazard evaluation of in-coherent light sources toward new instrumentation for practical point of view and standardization.
- Piloting international comparison organized under CCPR and APMP such as CCPR-K4.2017 (luminous flux), APMP.PR-K3.a (luminous intensity) and APMP.PR-S5 (laser power responsivity).

3. What work in PR has been/will be terminated in your laboratory, if any, in the past /future few years? Please provide the name of the institution if it has been/will be substituted by a DI or accredited laboratory.
   - Spectral responsivity in the wavelength range 1) from 10 nm to 90 nm and 2) from 140 nm to 200 nm.
4. What are present, new or emerging needs of users of your services that are not being supported sufficiently by current CCPR activities or initiatives? In the light of this information please suggest desirable changes in the future working program of the CCPR.
   - N/A
5. What priorities do you suggest for new research and development programmes at NMIs in the area of Photometry and Radiometry?

- Survey and development to find out alternative (or new) artefacts suitable for transfer standards used not only in photometry but also in spectroradiometry from UV to NIR region.

Are there any research projects where you might be looking for collaborators from other NMIs or are there studies that might be suitable for collaboration or coordination between NMIs?

- N/A

6. Have you got any other information to place before the CCPR in advance of its next meeting?

   - N/A

7. Bibliography of radiometry and photometry papers of your laboratory since the last CCPR (September 2016)?

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   D. Fukuda, K. Niwa, K. Hattori, S. Inoue, R. Kobayashi, and T. Numata, "Confocal microscopy imaging with an optical transition edge sensor", Journal of Low Temperature Physics, 193, 1228–1235, https://doi.org/10.1007/s10909-018-1938-8 (2018).

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   H. Iida, M. Kinoshita, and K. Amemiya, "Accurate measurement of absolute terahertz power using broadband calorimeter", Journal of Infrared, Millimeter, and Terahertz Waves 39, 409–421 (2018).

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R. Kobayashi, K. Hattori, S. Inoue and D. Fukuda, “Development of a Fast Response Titanium-Gold Bilayer Optical TES With an Optical Fiber Self-Alignment Structure”, IEEE trans. Appl. Supercond., 29, 2101105; doi: 10.1109/TASC.2019.2909978 (2018).

Y. Nakazawa, K. Godo, K. Niwa, T. Zama, Y. Yamaji and S. Matsuoka, “Development of LED-based standard source for total luminous flux calibration”, *Light. Res. Technol.*, First Published September 20, 2018, doi: 10.1177/1477153518800746.

K. Niwa, T. Numata, K. Hattori and D. Fukuda, “Few-photon color imaging using energy-dispersive superconducting transition-edge sensor spectrometry”, Scientific Reports, 7, 45660; doi: 10.1038/srep45660 (2017).

T. Numata, M. Tanabe, K. Amemiya, and D. Fukuda, "Response non-uniformity of beam profiling cameras at near-infrared laser wavelength," Applied Optics, 56(21), 5972–5977 (2017).

M. Tanabe and K. Godo, "Effect of spectroradiometer characteristics on chromaticity for tricolor laser light sources" Journal of the Optical Society of America A, 36(8), 1379-1384 (2019).

M. Tanabe and K. Kinoshita, "Supralinear behavior and its wavelength dependence of silicon photodiodes with over-filled illumination in visible range", Applied Optics, 57(13), 3575-3580 (2018).

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