EMRP Call 2010 - Industry & Environment

Topic number: SRT-25i

Title: Metrology for imaging photometry and uv radiometry for industrial applications

Abstract

Imaging luminance and radiance measurement devices are widely used in industry to measure the spatial luminance/radiance distribution of extended sources and surfaces. However, due to the complexity of such devices today no NMI is able to offer calibration services that take into account all characteristics as required in the wide spread of possible applications of these devices. This is also the case for UV radiometers which are used in a variety of industrial applications. This call for JRPs calls for the development of calibration techniques applicable for both of these devices. All of these instruments measure the effectiveness of photochemical/biological reaction of optical radiation as spectrally integrated quantity.

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP 2008 section on “Radiometry and Photometry” page 34, which the fields that need to be addressed most urgently:

“Novel optical radiometrical capabilities for industry, quality of life and environmental applications…The research challenges are the development of measurement techniques for large-volume and pixelled light sources, near-field to far-field transitions, and the development of camera-based photometry and radiometry”.

“Establishment of a unified radiometry from THz to EUV range… In the optical frequency range various technical innovations require improved metrological capabilities. Due to the multi-dimensional character of the radiation quantities in many of the applications a variety of parameters has to be measured simultaneously, e.g., wavelength spectrum, power level, angular and spatial distribution… The final goal is to provide highest level realisations of the basic and derived radiometric units combined with a rapid, low-cost dissemination via the calibration chains”. The proposed JRP will address a number of elements of these challenges.

Keywords

Photometry, imaging luminance measurement devices, luminance camera, UV radiometry, UV irradiance, near field characterisation, luminous product, devices characterisation, photometric near-field and far-field

Background to the Metrological Challenges

Development in the sophistication of light measuring devices is offering many benefits to a wide range of industries, however the metrology to support the practical use of these instruments has not kept pace. The challenge is to develop measurement techniques for these devices and to develop calibration facilities, traceable to the SI, with sufficient accuracy to support the industrial needs. Two examples of device types requiring metrological support are:

- Imaging luminance and radiance measurement devices are widely used to measure the spatial luminance/radiance distribution of extended sources and surfaces. This supports the building & lighting industries to map luminance of complex scenes, the safety industry as they seek to ensure adequate lighting, the automotive and aerospace industries in characterising luminaires and visual displays, plus many other industries. However, the complexity of devices has meant

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that no calibration services are currently available that address all the characteristics required for the wide range of industrial uses.

- UV radiometers are used in a variety of industrial applications, for example; the semiconductor industry, material curing, non-destructive testing, acceleration of chemical processes, water purification, sterilisation, phototherapy and solarium appliances etc. Often broadband UV radiometers are used, for which a recent comparison between NMI's [4] shows variations around 5 %. The variations are expected to be far higher at industrial level. Currently there are no internationally agreed standard procedures for the calibration of such UV radiometers, mainly due to the necessarily very high irradiance levels required during calibration. The accuracy or the uncertainty of measurement achievable using this type of radiometers is influenced by many factors, such as the spectral and directional characteristics of the radiometer, aging of the radiometer including filter and windows, operating conditions and geometry, environmental conditions and the spectral and spatial characteristics of the UV sources to be measured.

The technical committees of the CIE [1] are working closely together to address the problem of harmonisation of characterisation and calibration techniques:

- CIE TC2-40 CIE/ISO Standard on characterising the performance of illuminance and luminance meters
- CIE TC2-47 Characterisation and Calibration Methods of UV Radiometers
- CIE TC2-59 Characterisation of Imaging Luminance Measurement Devices
- CIE TC2-62 Imaging-photometer-based Near-Field Goniophotometry
- CIE TC4-26 Systems for Measurement of Photometric Quantities of Road Lighting Installations).

There is a pressing demand from industry and from the standardisation bodies to classify measurement instruments according to their performance.

Scientific and Technological Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them, in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the JRP protocol.

The aim of this SRT is to provide validated and reliable measurements/methods with traceability wherever it is practical to do so and to:

- Develop and validate measurement techniques for the quality indices defined by the CIE, to consistently describe the performance of imaging photometers and UV radiometers
- For imaging luminance measurement devices, ensure that the techniques are suitable for component characterisation, device characterisation, and installed lighting characterisation
- Develop calibration techniques for such measurement instruments, which can then also be directly transferred to imaging radiance meters (IRMDs).

This includes the following objectives:

1. Modelling and characterisation of imaging luminance/radiance measurement devices (ILMD/IRMD)
2. Development of calibration sources for imaging metrology
3. SI-traceable calibration of UV-Radiometers used in industry
4. Uncertainty evaluation in applications and user guidelines

Proposers shall give priority to work that meets documented industrial needs and that which supports transfer into industry e.g. by cooperation and/or by standardisation.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this. Proposers must ensure that they are familiar with the existing EURAMET funded Joint Research Projects (link below); proposers must explain how the project is different from the previously funded work, and describe the scientific and technological steps beyond the state of the art.

- ENG05 Solid State Lighting http://www.euramet.org/index.php?id=a169jrps

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the "end user" community. This may be through the inclusion of unfunded JRP partners or collaborators, or by including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the "end user" community (eg letters of support) is encouraged.

Where a European Directive or other regulatory requirement is referenced in the proposal, the relevant paragraphs identifying or demonstrating the need for the project should be quoted and referenced. It is not sufficient to quote the entire Directive per se as the rationale for the metrology need. Proposals must also clearly link the identified need with the expected outputs from the project.

You should also detail other Impacts of your proposed JRP as detailed in the document "Guidance for writing a JRP"

You should detail how your JRP results are going to:

- feed into the development of standards through appropriate standards bodies; including the CIE.
- transfer knowledge to the industrial sector.
- link to and build on the existing EMRP funded project ENG05 Solid State Lighting.

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of 3 years duration.

Additional information

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

[1] International Lighting Committees CIE (http://www.cie.at.co)

[2] Thematic Network for Ultraviolet Measurements, Contract No : SMT4-CT97-7510 (DG12 - EGAA), http://metrology.tkk.fi/uvnet

[3] DIRECTIVE 2006/25/EC, on the minimum health and safety requirements regarding the exposure of workers to risks arising from physical agents (artificial optical radiation).

[4] http://www.bipm.org/utils/common/pdf/final_reports/PR/S1/APMP.PR-S1.pdf