**EMRP Call 2012 – Open Excellence, Industry and SI Broader Scope**

Selected Research Topic number: **SRT-s18**
Version: 1.0

# Title: Traceable camera-based photometry and radiometry


## Abstract

Recent developments in light measuring devices are 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 JRP should develop measurement techniques and calibration facilities traceable to the SI for imaging luminance and radiance measurement devices.


## Conformity with the Work Programme

This Call for JRPs conforms to the EMRP Outline 2008, section on “Grand Challenges” related to Industry & Fundamental Metrology on pages 33 and 34.


## Keywords

Photometry, radiometry, imaging luminance measurement devices (ILMD), luminance camera, near field far field transition, imaging radiance measurement device (IRMD), spatial temperature distribution,


## Background to the Metrological Challenges

Cameras have been successfully used for imaging, when just a contrast among different pixels is needed for getting qualitative information. However, quantitative information can be obtained from cameras if an accurate relation can be established between a pixel’s digital level and the radiance of the source imaged on it, turning the camera into an imaging luminance and radiance measurement device. This allows the characterisation of inhomogeneous sources, determining the luminance or radiance of different parts within the source in just “one shot”.

Imaging luminance and radiance measurement devices are widely used to measure the spatial luminance/radiance distribution of extended sources and surfaces, especially for heterogeneous sources. 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, the designers of novel energy saving luminaires containing solid state lighting products, the monitoring of different processes when high temperature has to be maintained under certain values or a given homogeneity has to be kept. In many of these fields relative measurements are not sufficient, as the results are to be compared under various measurement conditions.

Despite the development of good measuring instruments, the complexity of these devices has meant that no calibration services are currently available that address all the characteristics required for measurements traceable to the SI – neither for the complex responsivity of the imaging measurement device nor for pixelled sources which can only be traceably measured by imaging luminance or radiance. Neither are there any internationally agreed testing procedures available and consequently there is currently no basis for measurements using Imaging luminance and radiance measurement devices to conform to ISO 17025.

## 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 JRP shall focus on the traceable measurement and characterisation of imaging luminance/radiance measurement devices (IxMDs), so that the luminance (radiance) of every part of a scene can be known with the lowest uncertainty at present state of the art of IxMD technology.

The specific objectives are

1. Establish vendor independent characterisation parameters of IxMDs
2. Develop and characterise dedicated IxMD calibration facilities and sources, including spectral analysis systems
3. Evaluate the uncertainty for the calibration of IxMDs, taking into account the characteristics of inhomogeneous sources: spatial and angular distribution
4. Develop uncertainty evaluation and guidelines for the use of calibrated IxMDs, based on a representative set of test measurements

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the research work, the involvement of the larger community of metrology R&D resources outside Europe is recommended. A strong industry involvement is expected in order to align the project with their needs and guarantee an efficient knowledge transfer into industry.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this, and the current development in the following EMRP JRPs:

- ENV04 MetEOC “Metrology for Earth observation and climate”

The total eligible cost of any proposal received for this SRT is expected to be around the 2.7 M€ guideline for proposals in this call. The available budget for integral Research Excellence Grants is 42 months of effort.

## 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.

You should detail how your JRP results are going to:

- feed into the development of urgent documentary standards through appropriate standards bodies
- transfer knowledge to the photometry and radiometry sector.

You should detail other impacts of your proposed JRP as detailed in the document “Guide 4: Writing a Joint Research Project”

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 and includes the best available contributions from across the metrology community. 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 up to 3 years duration.