



International Commission on Illumination  
Commission Internationale de l'Eclairage  
Internationale Beleuchtungskommission

## **7 Visual Appearance: Perception, Measurement and Metrics**

### **7.1 Description of research**

The overall objective of this research topic is to define metrics describing the appearance of various materials in order to support relevant stakeholders (e.g. the automotive, cosmetics, paper, printing, coatings, plastics industry, etc.). In addition to the definition of a metric, measurement tools, methods and transfer artefacts shall be provided, in order to characterize modern surfaces and to ensure traceability of measurement to the SI and a reliable and well-managed visual and instrumental correlation.

Colorimetry is based on the measurement of spectral reflectance or transmittance, and, in general, is an established science that is possible using commercial instrumentation available at reasonable cost. Two shortcomings, however, are identified: First, there are a number of modern materials where colour measurements made by using a single pair of influx/efflux geometries is not sufficient to describe the perceived colorimetric effect. Thus, measurement at more influx/efflux angle combinations is required. Second, the traditional CIE-recommended colorimetric parameters, while providing correlates of visual percepts, are not able to predict the absolute appearance of a coloured sample under various conditions; colour appearance models are now able to do this.

The scientific and technical objectives of this research topic are to investigate advances in the measurement of appearance parameters including gloss, texture, whiteness and goniometric techniques. A more detailed description of the framework for the measurement of visual appearance is given in CIE 175:2006.

### **7.2 Key research questions**

- What are the relevant parameters to describe appearance, gloss and translucency of various materials, including goniochromatic and sparkling samples?
- Which BRDF geometry (size, polarization, shape and uniformity of the illuminated area) according to the type of sample under investigation shall be standardized?
- If a simplified geometry is used as a standardized description of effect materials, how can the “uncertainty” with respect to the real visual appearance, i.e. the proficiency of the test method, be described?

### **7.3 Justification of the need for the proposed research topic**

Visual appearance is one of the most critical parameters affecting customer choice and needs in products; therefore it should be quantifiable to ensure uniformity and reproducibility. The industry will directly benefit from:

- Improved measurement technology - leading to better quality control:  
Research will highlight the critical parameters in the design and use of measurement devices used to quantify the appearance of an object. The goal is to understand some of the problems, to provide a framework describing the relationships between the various proposed measurement parameters, and to encourage others to contribute the findings of their research to the knowledge base that will support the framework.
- Access to and support of measurement traceability:  
Success in defining new measurement scales can be enhanced by understanding all the aspects that influence the measurement, and quantify their contributions to the measurement uncertainty. Once a primary scale is established, traceability of industry-based measurement systems is possible.

#### 7.4 Related current activities in CIE

<a href="#">TC 1-95</a>	<a href="#">The Validity of the CIE Whiteness and Tint Equations</a>
<a href="#">TC 2-85</a>	<a href="#">Recommendation on the geometrical parameters for the measurement of the Bidirectional Reflectance Distribution Function (BRDF)</a>
<a href="#">TC 8-14</a>	<a href="#">Specification of Spatio-Chromatic Complexity</a>
DR 1-53	Gloss Perception and Measurement
DR 2-64	Technical Note on Errors of Measurement in Spectrophotometry
DR 2-74	Physical characterisation of new visual effects in the field of appearance of materials

#### 7.5 Existing CIE publications

<a href="#">CIE 038-1977</a>	<a href="#">Radiometric and Photometric Characteristics of Materials and their Measurement</a>
<a href="#">CIE 044-1979</a>	<a href="#">Absolute Methods for Reflection Measurements</a>
<a href="#">CIE 046-1979</a>	<a href="#">A Review of Publications on Properties and Reflection Values of Material Reflection Standards</a>
<a href="#">CIE 054.2-2001</a>	<a href="#">Retroreflection: Definition and Measurement</a>
<a href="#">CIE 076-1988</a>	<a href="#">Intercomparison of Measurements of (Total) Spectral Radiance Factor of Luminescent Specimens</a>
<a href="#">CIE 130-1998</a>	<a href="#">Practical Methods for the Measurement of Reflectance and Transmittance</a>
<a href="#">CIE 175:2006</a>	<a href="#">A Framework for the Measurement of Visual Appearance</a>
<a href="#">CIE 176:2006</a>	<a href="#">Geometric Tolerances for Colour Measurements</a>
<a href="#">CIE 182:2007</a>	<a href="#">Calibration Methods and Photoluminescent Standards for Total Radiance Factor Measurements</a>