6 Application of CIE 2015 Cone-Fundamental-Based CIE Colorimetry

6.1 Description of research

Since colorimetry was established in 1931, considerable improvements in the metrology of the colour stimulus and immense advances in the knowledge of colour vision have been made. Based on the modern knowledge of the human colour visual system CIE published a set of new colour-matching functions that takes into consideration the age of the observer and the field size of the stimulus, and provides a method to derive the associated chromaticity diagram (see CIE 170-2:2015).

The objective of this research is to conduct field trials that compare the results of the use of the CIE 1931 (2°), CIE 1964 (10°) and CIE 2015 cone-fundamental-based colour-matching functions, especially when applied to LED lighting and in imaging applications. Also the method to be used to calculate the CIE 2015 cone-fundamental-based colour-matching functions needs to be standardized.

6.2 Key research questions

- How accurate are cone-fundamental-based colorimetry results compared with those of 1931 and 1964 in predicting typical colorimetry applications such as colour difference, colour appearance, whiteness, colour rendering, etc.?
- Can the cone-fundamental-based colorimetry be used to quantify the age metamerism effect and the size metamerism effect? There is an urgent need to quantify observer metamerism. Evidence suggests that the earlier CIE method underestimates these effects.

6.3 Justification of the need for the proposed research topic

It is occasionally experienced that object colours do not visually match though the colorimetric values are the same. There is strong evidence that there can be significant errors in the current colour specification using the CIE 1931 standard colorimetric observer applied to typical white LED light sources. The CIE 1931 colorimetric system needs to be improved possibly by adopting the CIE 2015 cone-fundamental-based colorimetric system for the calculation of colorimetric parameters to be used for the computation of lighting quality data. Therefore, intensive field trials are required to help the colour, imaging and lighting industries to have confidence that CIE 2015 cone-fundamental-based colorimetry is fit for their use.

The CIE 2015 cone-fundamental-based colorimetry has established a link between colorimetry and physiology. This link will improve the understanding of colour, will be useful for education and will offer novel opportunities to solve problems of colour measurement and colour perception in everyday life and industry.

6.4 Related current activities in CIE

TC 1-93	Calculation of Self-Luminous Neutral Scale
TC 1-97	Age- and Field-Size-Parameterised Calculation of Cone-Fundamental-Based Spectral Tristimulus Values
JTC 9 (D1/D2/D3/D6)	Quantifying ocular radiation input for non-visual photoreceptor stimulation

6.5 Existing CIE publications

CIE 170-1:2006	Fundamental Chromaticity Diagram with Physiological Axes - Part 1
CIE 170-2:2015	Fundamental Chromaticity Diagram with Physiological Axes – Part 2: Spectral Luminous Efficiency Functions and Chromaticity Diagrams

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