

# CIE Work in Color Imaging

*Alan R. Robertson*

*Institute for National Measurement Standards  
National Research Council of Canada  
Ottawa, Ontario, Canada K1A 0R6*

*Janos Schanda*

*Department of Image Processing and Neurocomputing  
University of Veszprem, Hungary*

*Todd Newman*

*Canon Information Systems  
20300 Stevens Creek Blvd., Suite 100  
Cupertino, California 95014*

## **Abstract**

The CIE Board of Administration has proposed a new Division to study procedures and prepare guides and standards for the optical, visual and metrological aspects of the communication, processing, and reproduction of images, using all types of analogue and digital imaging devices, storage media and imaging media. While current practice enables adequate color communication within single industries, such as publishing or television, it was felt that more effort was needed to make the data produced within these industries readily useable in other areas. The CIE is the most appropriate body in which to do this since illumination, vision and measurement are all topics within its scope and are all essential components in specifying and controlling the digital reproduction of color images.

## **Introduction**

At a Symposium held by the CIE immediately after the 5th Color Imaging Conference in Scottsdale in November 1997, the question of color standardization for imaging technologies was discussed. Participants requested the CIE to set up a new Division to speed up development in this field. The request was later endorsed by the ISO/IEC JTAG 2 meeting in January 1998. The CIE responded positively and, in June 1998, its Board of Administration voted unanimously in favour of establishing a new Division, to be known as Division 8 (Image Technology). At the time of writing, a ballot of National Committees is underway to approve this decision and a preliminary meeting of the

Division is planned for Baltimore, Maryland, USA on 29 September 1998.

## **New CIE Division**

The Terms of Reference proposed for the new Division are: "To study procedures and prepare guides and standards for the optical, visual and metrological aspects of the communication, processing, and reproduction of images, using all types of analogue and digital imaging devices, storage media and imaging media."

To alleviate the concern that forming a new Division might further fragment activities and make it difficult or impossible for some experts to take part, the new Division will work very closely with the two existing CIE Divisions most closely connected to image technology, Division 1 (Vision and Colour), and Division 2 (Physical Measurement of Light and Radiation). It will be equally important to co-operate closely with other standards committees, outside the CIE, to avoid duplication and to ensure that the necessary work is done by the most qualified experts and without undue delay. IEC/ISO JTAG2 will have an important role in this as its responsibility is to provide liaison and co-ordination of international technical standards committees whose work involves imagery, including, but not limited to, the optical, visual and metrological aspects proposed for the CIE. In this connection, the CIE already has a Memorandum of Understanding with IEC and ISO to avoid duplication of work in the field of lighting i.e. light sources, color, photometry, colorimetry, and illuminating engineering.

Likely work items for the new CIE Division will be to study procedures and to establish standards for the communication, processing, and reproduction of color images (including monochrome images), using devices such as analogue and digital cameras, scanners, video displays, printers, and printing presses and working within and between media such as print, television, film, textiles, and office equipment. It is recognized that current practice enables adequate color communication within industries, such as publishing or television. However, more effort is needed to make the data produced within these industries readily useable in other areas. The solution must come from a body that is deemed to be unbiased, authoritative, and capable of reaching decisions in a timely manner.

Experts from the various industries are working in a number of bodies to solve these problems, but the efforts are felt to be uncoordinated, sometimes contradictory and, quite often duplicating each other. There is much support for coordinating all these efforts and it is felt that the CIE is the most appropriate body in which to do this. Illumination, vision and measurement are all topics within the scope of the CIE and are all essential components in specifying and controlling the digital reproduction of color images. No other such professional society or forum exists. Many deal with particular aspects of digital imaging but none covers the whole range of topics so well with authority and intellectual credibility.

The new division will use modern technologies in developing its standards and technical reports, enabling it to be responsive to the needs of its clients and stakeholders. For example, it is proposed that the bulk of the work of the new Technical Committees that will be formed should be done by e-mail and other forms of electronic communication, with infrequent physical meetings. This method of working allows people to read, think, and respond to discussion at their convenience and provides a good atmosphere for making compromises.

Some specific topics that have been proposed for the new Division include calculation of the white point in mixed-illumination environments, continuation of work on color-appearance modeling and possible development of CIECAM97s (see below) into an international standard, gamut mapping, and communication of color information. The Division will have a preliminary meeting in September 1998. This will enable more details to be presented in the oral version of this paper.

### **Other CIE Divisions**

In parallel with the organization of this new work, work continues in a number of existing CIE Technical Committees related to imaging. Some examples follow.

At the 1996 CIE Symposium on Colour Standards for Imaging Technology a request for an interim color appearance model was formulated. CIE responded with its CIECAM97s model, which was introduced at the 1997 Color Imaging Conference and has now been published as CIE Publication 131<sup>1</sup>. The model was developed by CIE TC 1-34 which decided to formulate a single model with a simple version for many practical applications and a comprehensive version for a wider range of viewing conditions and phenomena. CIECAM97s is the simple version and the extension to a comprehensive version will be formulated and published in the future.

Since its introduction several studies have been performed that deal with the application and features of the new model. One group of studies focused on the cognitive effects and investigated the influence that short term and long term memory has on color identification and on the uniformity of the color space built by using the CIECAM97s formula. Hue, chroma, and brightness scales can be constructed using the CIECAM97s metric, and can be tested for linearity. Experiments performed up to now show that CIECAM97s describes chroma and brightness scales quite well<sup>2</sup>. Analysis of the results of such experiments is expected to be a task of a follow up committee of TC 1-34 either in Division 1 or in the new Division 8.

Important work with probable long-term implications for all applications of color science, including image technology, is being undertaken by CIE TC1-36 whose terms of reference are to establish a chromaticity diagram of which the co-ordinates correspond to physiologically significant axes. This will include the choice of a set of color-matching functions and estimates of cone fundamentals for the normal observer, taking into account the variability amongst normal and dichromatic observers. A progress report was published in the proceedings of the 1996 CIE Experts' Symposium<sup>3</sup>. The committee has agreed on proposing a continuous fundamental observer for field sizes from 1° to 10° based on the CIE 1964 supplementary standard colorimetric observer. Corrections for lens optical density, macular pigmentation, and photo-pigment optical density are being prepared.

Work also continues on daylight description and standards. Description of daylight phases is done by using the concept of correlated color temperature, based on the CIE 1964 (u,v) uniform chromaticity diagram. Recent investigations have shown that the 1976 (u',v') diagram describes the visual sensation better. CIE TC 1-48 is working on a new edition of CIE's fundamental publication on colorimetry<sup>4</sup> and it is most likely that this recommendation will be part of the new edition.

TC 1-44 is charged with investigating practical daylight sources for colorimetry, by inter-comparing existing daylight simulators for color measuring instruments and color matching booths in order to recommend practical methods for simulating daylight sources. A related committee, TC 1-45 is preparing a revision of the CIE method of assessing daylight simulators<sup>5</sup> to include the assessment of D50 simulators. This will be done by defining suitable metamers. It is likely that the Committee will adopt existing metamers that have been proposed and will extend the spectral range to 380 to 780 nm, for assessing D50, D55, D65, and D75 daylight simulators.

Work is continuing on a color rendering description for video display units. This work might be based on a new version of the CIE Color Rendering Index calculation, comparing the color of real scenes with that obtainable on a monitor. Actual visual work has shown that the preferred white on the screen is more bluish white than that of the original substance if the white surface can be coupled to well known object, such as a white shirt<sup>6</sup>. CIE TC 1-33 is entrusted with the updating of the calculation method of colour rendering of light-sources. It has been suggested that a Technical Committee in Division 8 might extend this work to get an index describing monitor colour rendering and to develop methods to incorporate aspects of colour preference, including cognitive factors into colour transformations.

In Division 2, an important committee from the image technology point of view is TC 2-42 which is charged with preparing a Technical Report summarizing recommended practice for the measurement of the colorimetric and spectroradiometric properties of visual displays. This committee is coordinating closely with activities in the IEC.

It is possible that some of the activities of Division 1 and 2 will be transferred to the new Division 8, but the main emphasis will be on ensuring that the work gains the attention of the most appropriate experts and is completed in a timely fashion and with adequate co-ordination.

## Conclusion

The formation of a new Division of the CIE to deal with image technology issues offers an opportunity for experts traditionally associated with the CIE to join with image technology experts and work together in a coordinated way to develop techniques and standards that will satisfy the needs for optical, visual and metrological procedures that can specify and relate images, using all types of imaging devices, storage media and reproduction techniques. The CIE is the most appropriate body in which to do this since illumination, vision and measurement are all topics within its scope and are all essential components in specifying and controlling color images.

## References

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