



COMMISSION INTERNATIONALE DE L'ECLAIRAGE  
INTERNATIONAL COMMISSION ON ILLUMINATION  
INTERNATIONALE BELEUCHTUNGSKOMMISSION

## DIVISION 1: VISION AND COLOUR

### MINUTES of the 4<sup>th</sup> Meeting of the McFadden Term

**Tuesday 10 July 2007**

**Beijing, China**

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#### ATTENDANCE

<b>Officers</b>	Sharon McFadden	CA	DD - Director
	Françoise Viénot	FR	ADV Assoc. Director
	Mike Pointer	GB	ADC Assoc. Director
	Ellen Carter	US	DE - Editor
	Yasuhisa Nakano	JP	DS - Secretary

#### Country Representatives

The following 18 countries were represented:

Australia	Hungary
Belgium	Italy
Brazil	Japan
Bulgaria	Korea
Canada	Slovakia
China	South Africa
France	Spain
Germany	Switzerland
Great Britain	USA

#### Technical Committee Chairpersons

The following TC Chairs and Reporters were present:

Paula Alessi	US	TC1-27
Yasuhisa Nakano	JP	TC1-30
Françoise Viénot	FR	TC1-36
Ken Sagawa	JP	TC1-37, TC1-54
Miyoshi Ayama	JP	TC1-42
Robert Hirshler	HU	TC1-44
Michael Brill	US	TC1-56
Alan Robertson	CA	TC1-57
Taiichiro Ishida	JP	TC1-61
Peter Bodrogi	HU	TC1-62, TC1-68
Klaus Richter	DE	TC1-63
Sharon McFadden	CA	TC1-64
Mike Pointer	GB	TC1-65
Janos Schanda	HU	TC1-66
Hiroyasu Ujike	JP	TC1-67
Wendy Davis	US	TC1-69
Hirohisa Yaguchi	JP	R1-19
Nina Itoh	JP	R1-37
Yasuhisa Nakano	JP	R1-38
Mike Pointer	GB	R1-39

**Guests** In addition there were approximately 30 guests present

<b>Apologies</b>	Gunilla Derefeldt	SE	
	Andy Chalmers	NZ	
	Marta Klanjšek Gunde	SI	
	Eugenio Martinez-Uriegas	ES	TC1-60
	Manuel Melgosa	ES	TC1-55
	Robert Seve	FR	
	Rengin Unver	TR	
	Pieter Walraven	NL	TC1-41

**Total attendance:** Approximately 50 persons

**1. WELCOME**

The Division Director, Sharon McFadden, welcomed all those present and thanked the hosts for all of their efforts in organising the meeting. She then introduced the retiring President of CIE, Wout van Bommel, the incoming President, Frantz Hengstberger, and the new General Secretary, Martina Paul. The incoming Vice President Technical, Janos Schanda, was also present.

**2. ANNOUNCEMENTS**

The book on Colorimetry that was prepared in association with the CIE meeting in Ottawa 2006 is to be published by Wiley in July 2007 at a CIE discount price of \$97.75.

**3. ATTENDANCE**

18 countries were officially represented.

**4. MEMBERSHIP**

The following changes in national representative were noted:

Belgium: From Jean-Jacques Embrechts to Peter Hanselaer  
Brazil: Juliana Freitas Santos Gomes

**5. CONFIRMATION OF THE AGENDA**

The agenda was confirmed as in Appendix 1.

**6. MINUTES**

The Minutes of the 2006 meeting held in Ottawa, Canada were approved with one change.

**7. MATTERS ARISING FROM THESE MINUTES**

There were no matters arising not covered by items on the agenda.

**8. DIVISION OFFICER REPORTS**

**8.1 Director**

The DD reported that there had been five publications by D1 since the last meeting:

- CIE 170-1:2006. Fundamental chromaticity diagram with physiological axes – Part 1. (TC1-36)
- DS 014-4 Colorimetry – Part 4. CIE 1976 L\*a\*b\* colour space. (TC1-57)
- x030:2006. Proceedings of the ISCC/CIE Expert Symposium '06, 75 Years of the CIE Standard Colorimetric Observer, 16-17 May 2006, NRC, Ottawa, Ontario, Canada.
- CIE 175:2006. A framework for the measurement of visual appearance. (TC1-65)
- CIE 177:2007. Colour rendering of white LED light sources. (TC1-62)

A very successful Expert Symposium on Visual Appearance had been organised by TC1-65 in Paris, France, 19-20 October 2006.

The CIE BA met in October 2006 and approved the establishment of the following new TCs and Rs:

TC1-69 Colour Rendition by White Light Sources. Chair:  
Wendy Davis US

R1-39 Alternative Forms of the CIE DE 2000 Colour Difference Equation.  
Mike Pointer GB

R1-40 Scene Dynamic Range  
Jack Holm US

The BA also approved that M Ronnier Luo be appointed the next DD of D1.

The BA has reviewed the membership conditions for TCs. It is proposed that, in future anyone wishing to join a TC must write to the TCC, copied to the DD and the DS, giving a clear commitment to actively participate in the work of the TC (if accepted as a TC Member) and stating what expertise they have in the technical area covered by the Terms of Reference of the TC, including a list of any relevant publications, and which specific aspects of the work of the TC they feel best able to contribute to.

These suggested changes to the relevant Guidelines have yet to be approved. When approved they will be available on the CIE website.

## 8.2 Secretary

The DS reported that the Activity Report produced in January 2007 was now available on the D1 website. In addition he had established a bulletin board for the use of members.

## 8.3 Editor

The DE reported that she had produced an Activity Report in January 2007. She had also edited CIE publications 175:2006 and 177:2007 (see above) as well as a draft TR from TC1-44. TC1-55 has produced guidelines to encourage research into colour differences and these had been edited and published in Color Research & Application.

## 9. TECHNICAL COMMITTEE REPORTS

### 9.1 Vision: Françoise Viénot

#### **TC1-30 Luminous Efficiency Functions: Yasuhisa Nakano JP**

It was agreed that some of the work required by the Terms of Reference of this TC was no longer necessary and that the TC should be closed with a Reporter established to cover the additional items – see New Work Items below.

The national members present agreed that this TC be disbanded.

#### **TC1-36 Fundamental Chromaticity Diagram with Physiologically Significant Axes: Françoise Viénot FR**

Part 1 of a TR has been published as CIE Publication 170:2006. This includes the following chapters:

Ch.1. Introduction

Ch.2. Fundamental response curves for the 10° observer

Ch.3. Derivation of the photopigment absorption spectra

Ch.4. Fundamental response curves for the 2° observer

Ch.5. A field size and age dependent observer

Ch.6. Tables of data

Work is now in progress on Part 2 of the report which will contain the following chapters:

- Ch.7. Photometric aspects; the choice of the  $V_{10}(\lambda)$  curve and the  $V_2(\lambda)$  curve,  $VF(\lambda)$
- Ch.8. Development of 2-dimensional chromaticity diagrams
- Ch.9. Conclusions and recommendations
- Ch.10. Tables of data

One member has submitted a manuscript, for publication in a journal, that proposes an XYZ representation of the cone fundamentals. Once this is published it will be possible to complete this work.

#### **TC1-37 Supplementary system of Photometry: Ken Sagawa JP**

In 2006, the Chairman published a scientific paper in the *Journal of Ophthalmic and Physiological Optics*, (OPO **26**:2006, 240-245) which addressed problems, points of consideration, current state of the art, etc, concerning the development of a CIE Supplementary System of Photometry. Based on this article, a CIE technical report is currently being prepared with the following chapter:

- Ch.1. Introduction: problems, needs, and a history of supplementary systems of photometry
- Ch.2. Scope: *Photometry for brightness at photopic, mesopic, and scotopic levels for a large(10-degree) field.*
- Ch.3. Equivalent luminance,  $Leq$  (for brightness) with a reference at 555nm, (683lm/w at 555 nm), photopic 2-degree field luminance, a steady light and for young normal observers
- Ch.4. A photometric system for brightness at any level including calculation of  $L$  and  $L'$ ; calculation of the chromatic contribution using the Nakano formula (1999), a determination of coefficient  $a$  and  $a_c$  (the contribution of colour), and the calculation of  $Leq$  using the formula  $Leq = (L)^a(L')^{1-a}$ .
- Ch.5. Calculation (or measurement) example

#### **TC1-41 Extension of $VM(\lambda)$ Beyond 830nm: Pieter Walraven NL**

This work awaits the completion of the work of TC1-36 before it can proceed.

#### **TC1-42 Colour Appearance in Peripheral Vision: Miyoshi Ayama JP**

This TC met in Beijing and is actively writing a draft TR which the TCC hopes to complete later this year. The chapters are:

- Ch.1. Introduction
- Ch.2. Principle of the method to evaluate colour
- Ch.3. Colour zone map
- Ch.4. Experimental conditions and field eccentricity
- Ch.5. Results
- Ch.6. Conclusion

#### **TC1-54 Age-Related Change in Visual Response: Ken Sagawa JP**

On behalf of the BA, the Chairman has been developing guidelines for lighting for elderly and disabled people and TC 1-54 has joined in this work with the data collected so far in the TC being adopted in the draft version of the guidelines. Division 3 is intending to have a TC on the same subject and, when it established, TC1-54 will have a liaison and ask for their cooperation. The aim is to complete the guidelines by the end of 2007.

So far, data on spectral luminous, visual acuity, contrast sensitivity function, colour category, and visual field have been collected, and these data have been submitted to the CIE BA for publication in "CIE Guidelines on Accessibility".

Contents of these Guidelines are:

- Part 1: Guidelines to address the needs of older persons and persons with disabilities.
- Part 2: Technical guidelines and data of visual functions relevant for accessible design

in light and lighting.

#### **TC1-58 Visual Performance in the Mesopic range: Liisa Halonon FL**

The aim of the Beijing meeting was to present an analysis of the MOVE- and X-models based on three new independent data-sets, to present a draft of the contents of the proposed TC report and to agree on the specific contents, and to discuss the required future actions needed to accomplish the TC work.

The chairman presented the TC working programme which is divided into three main tasks according to the terms of reference. In the working programme analysis of new data and modelling of mesopic data are still in progress. After these are completed the TC can propose a model for the basis of performance-based mesopic photometry. The aim is to finalise the TC work within four years from its start: by June 2008.

Three presentations were given of recent research work done in the mesopic field.

A proposed Integrated-system of photometry *by Teresa Goodman, NPL UK*

Visions for a mesopic luminance-evaluation *by Stephan Völker, L-Lab Germany*

Analysis of performance based mesopic models and required future actions

towards a solid proposal for future performance based mesopic photometry *by Marjukka Eloholma, HUT Lighting Laboratory Finland*

The TC report contents were discussed. It was suggested that the order of the Chapters be changed so that the outcome of TC work (the proposed model) will first be introduced, to be followed by the other chapters. This was agreed.

The next TC meeting (5<sup>th</sup> meeting) will be held in Eindhoven, Netherlands on November 9, 2007 along with the 'Light, Performance and Quality of Life' Symposium.

#### **TC1-60 Contrast Sensitivity Function for Detection and Discrimination: Eugene Matinez-Uriegas ES**

Different groups of members are working on different chapters of draft 3 of a TR:

Introduction/philosophy of the approach of the technical report.

Search for data and conditions

Preparing tables of data and conditions

Combining data sets – analysis and review of data

#### **TC1-67 The Effects of Dynamic and Stereo Visual Images on Human Health: Hiroyasu Ujike JP**

This TC is considering three different aspects of the subject: photosensitive seizures (PSS), visually induced motion sickness (VIMS) and visual fatigue caused by stereoscopic images (VFSI). The TCC is involved with related work in ISO TC 159 (Ergonomics)/SC4 (Ergonomics of human-system interaction)/SG on Image Safety. This has Terms of reference to write a report on a strategy of standardization to reduce the incidence of undesirable biomedical effects of moving images in terms of PSS, VIMS, and VFSI for completion in mid 2008. The TC is currently working on a draft TR on PSS, also to be completed by mid 2008:

Ch.1. Introduction and Background

Ch.2. Definition of terms

Ch.3. Prevalence and incidence

Ch.4. Type of seizure

Ch.5. Evaluation Methods

Ch.6. Visual Stimuli

6.1. Flash

6.2. Pattern

6.3. Patho-Mechanisms

Ch.7. Counter Measures

7.1 Reduction of stimulus

7.2 Rationale for the Recommendations

7.3. Counter Measures: reduction of patients' sensitivity

Work on a TR on VIMS will start later in 2007, and on VFSD in early 2008.

### **R1-19 Specification on Individual Variation in Heterochromatic Brightness Matching: Hirohisa Yaguchi JP**

The reporter has surveyed papers on heterochromatic brightness matching in terms of individual difference and examined the possibility to develop a simple test of individual characteristics for heterochromatic brightness matching. A report has been sent to the Division Director. Various factors of individual differences in brightness sensation are discussed including the optical density of the ocular media in eye, the physiological mechanism of brightness and the psychological attitudes of the observers. Experimental data of the spectral luminous efficiency functions for brightness from 18 papers are surveyed and reviewed in terms of the individual difference. The possibility to develop a simple test of individual characteristics for heterochromatic brightness matching is discussed. The chapters of the report are as follows:

Ch.1. Introduction

Ch.2. Datasets of heterochromatic brightness matching for photopic luminance level

2.1 Spectral color

2.2 Non-spectral color

Ch.3. Analysis of datasets

Ch.4. Models for heterochromatic brightness matching

Ch.5. Specification on individual variation in heterochromatic brightness matching

It was suggested that this report might be published in the CIE Collection, in which case two independent reviewers are required.

### **R1-23 Guidelines on Planning a Mesopic Photometry Investigation: Pat Trezona GB**

Communication with the Reporter has proved problematic and there is no report.

### **R1-35 Irregularity $y_{10}(\lambda)$ : Pieter Walraven NL**

No report.

### **R1-36 Action Spectra for Glare: Judith Fekete JP**

There were no publications about action spectra for glare in 2006. The Reporter has collected data and gave a presentation at the CIE Session in Beijing. A report is promised by the end of 2007.

### **R1-37 Definition of the Visual Field for Conspicuity: Nina Itoh JP**

The reporter has introduced additional studies on the aging effects of the useful viewing field.

The first group of additional studies is focused on the effect of the luminance difference of target and background on conspicuity and on the effects of the colour difference between the target and the background on conspicuity. Plots show the useful viewing field for older and younger subjects.

The second group of additional studies is focused on the effect of low vision on colour similarity and contrast sensibility.

From the measurement of the visual acuity and ratio of useful visual field, visual field deficiencies were classified into 3 types:

1. Moderate concentric constriction of visual field ( $>10^\circ$ )
2. Severe constriction of visual field ( $<10^\circ$ )
3. Central scotoma

Visual field deficiency causes a reduction of contrast sensitivity and an expansion of colour similarity.

The chairman plans to write a report and to propose a new TC next year.

**R1-38 Concept and Application of Equivalent Luminance:  
Yasuhisa Nakano JP**

A draft report has been prepared and will be reviewed by Françoise Viénot by the end of July.

**R1-40 Scene Dynamic Range: Jack Holm US**

A comprehensive report is included in the January 2007 Activity Report. It was recommended that this report be passed to D2 and D8 for comment and that members of those Divisions and also of D1 be encouraged to send comments to all D1 officers as well as to the reporter.

**9.2 Colour: Mike Pointer**

**TC1-27 Specification of Colour Appearance for Reflective Media and Self-Luminous Displays: Paula Alessi US**

A final report is being written and should be completed later this year.

**TC1-44 Practical Sources for Daylight Colorimetry: Robert Hirschler HU**

Two drafts of a TR have been circulated during the past year and this TC also met in Beijing. The chapters in the TR include discussion of the following:

- Daylight simulator technologies
- Daylight simulators for visual assessment
- Daylight simulators in colour measuring instruments
- Conclusions, recommendations
- ANNEX 1.* Standard methods for the evaluation of daylight simulators
- ANNEX 2.* Standards for the classification of daylight simulators

The report shows that daylight simulators for visual evaluation are satisfactory for D50 in only the visible range, they are commercially available and fully comply with the principal standards for D65 in the visible and UV, D75 is claimed but not proven. Daylight simulators for spectrophotometers are available for only D65 that give adequate daylight simulation according to all the relevant national and international standards when properly calibrated.

As far as methods for the evaluation of daylight simulators are concerned, two contributors reported very high correlation between the band values (BS 950) and the Mlvis values (CIE 51.2) of different simulators and large-scale visual evaluations for the visible range (non-fluorescent specimens). Evaluation given by the different standard methods for the UV range are often contradictory. There is not enough technical information available to confirm that the results achieved under a CIE 51.2 Category BC or better for a source for visual evaluation, compared to a Category BB or better source in instruments (as specified in the relevant standards), would render fluorescent samples, particularly coloured ones, correctly.

There is only one national standard for the specification of daylight simulators (ASTM D1729), and no international (application) standards specifying the acceptability limits for all three daylight simulators (D50, D65 and D75); the most widely quoted is ISO standard (3664:2000) but this is only applicable to D50, while ISO 3668 and ISO 11475 only apply to D65 (none apply to D75). This may be one of the reasons why the specifications given by quite a few of the manufacturers are unclear, contradictory or just plain exaggerated.

As far as UV calibration practices are concerned, it is common practice to adjust the UV/visible ratio of the illumination in one-monochromator spectrophotometers used for the measurement of fluorescent specimens (perform "UV calibration") to compensate for the loss of UV energy due to the aging of the lamp. UV-adjustment using the "CIE calibration" does not permit the comparison of measurement values

over the medium term on the same instrument and even in the short term on different instruments (even of the same model). UV-adjustment using the “Ganz-Griesser calibration” has not been internationally standardized. There are no practical methods and/or instruments that are easily available to verify the UV content of the daylight simulators in a visual booth.

The report makes the following recommendations:

**1. Competing technologies**

Colour-matching booths

The currently most widely used filtered tungsten +UV and fluorescent lamp technologies already produce acceptable daylight simulators; Manufacturers are urged to further exploit the potential of filtered xenon short-arc lamps to make high quality simulation achievable because the SPD of the source in the booths may be more similar to that used in spectrophotometers.

Spectrophotometers

For spectrophotometers there is very little ground to recommend any source other than the currently nearly exclusively used pulsed xenon lamp.

**2. Methods for the evaluation of daylight simulators**

The formation of a new TC is recommended – but not until this TC has completed its work):

“To intercompare standard and other published methods for the evaluation of daylight simulators, with particular reference to the rendering of (UV or visible excited, white or coloured) fluorescent specimens, and select or develop a method considered adequate in all respects; and  
To develop standard methods for the adjustment and verification of the UV/visible balance in colour matching booths and in single-monochromator spectrophotometers”.

**3. Recommendation for standard daylight sources**

The standardisation of any particular source (as “best representing daylight”) is not recommended.

**TC1-55 Uniform colour space for Industrial Colour-Difference Evaluation: Manuel Melgosa ES**

CIE TC 1-55 met in June 2006 at the University of Leeds (United Kingdom). A total of 11 people (members/advisors of this TC) participated. Following 4 short individual presentations from GB, IT, CZ and ES, discussions focused on available experimental datasets to be used by the TC, and the concept of ‘uniform colour space’ within the goal of our TC. A chairman’s request for existing experimental datasets on colour differences has been published in *Color Research and Application* **32**, 159 (2007). Recently different members of the TC have also published relevant papers in *Color Research and Application* and the *Journal Optical Society of America*. A website is being prepared for data interchange and the next meeting of the TC may be held to coincide with the Fourth European Conference on Colour in Graphics Image and Vision, CGIV 2008, Barcelona (Spain), June 10-13, 2008.

A further report can be found in the January 2007 Activity Report.

**TC1-56 Improved Colour Matching functions: Michael Brill US**

A revision of the Terms of Reference of the TC has been approved such that the TC will now concentrate on the testing of Grassmann’s Laws and the transformability of primaries. Three investigators have obtained data pertaining to these terms of reference, all published or in the process of publication. Further data are expected and work will now start on a draft TR that will, tentatively, recommend that Grassmann additivity continue to apply to Colorimetry except at low levels of luminance for which mesopic colour mechanisms must be considered.

### **TC1-57 Standards in Colorimetry: Alan Robertson CA**

TC1-57 is preparing four CIE standards, as follows:

- S 014-3 Colorimetry – Part 3: Calculation of CIE tristimulus values
- S 014-4 Colorimetry – Part 4: CIE  $L^*a^*b^*$  colour space
- S 014-5 Colorimetry – Part 5: CIE  $L^*u^*v^*$  colour space
- S 014-6 Colorimetry – Part 6: CIEDE2000 colour-difference formula

Part 3 is still at draft stage. The related work of TC2-60 (Effect of instrumental bandpass function and measurement interval on spectral quantities) is being monitored to be sure that the Standard does not conflict with potential recommendations of that TC. A new draft is planned for later in 2007.

Part 4 is now at the National Committee ballot stage with a deadline of 20-Aug-2007. The previous stage elicited an unexpectedly large number of comments from National Committees, some of which have led to clarifications in the Standard.

The third draft of Part 5 has recently been approved by the TC and passed to the Division Secretariat and the Central Bureau for division and Board of Administration ballots.

Work has not yet started on Part 6. The first draft is planned for later in 2007.

### **TC1-61 Categorical Colour Identification: Taiichiro Ishida JP**

This TC met in Beijing where data were presented using the CIECAM02 colour appearance model as opposed to the previous use of both CIELAB and Munsell space. It was agreed that work would now start on a TR describing the application of colour categorisation for surface colours, at different levels of illumination (1000 lx and 1 lx), using both Munsell and CIECAM02 to present the data.

### **TC1-62 Colour Rendering of White Light Sources: Peter Bodrogi HU**

With the publication of CIE 177:2007. Colour rendering of white LED light sources, this TC has completed its work. The national members present agreed that this TC be disbanded.

### **TC1-63 Validity of the Range of CIEDE2000: Klaus Richter DE**

This TC met in Beijing. The TC had earlier produced test charts with large colour difference patches that were equally spaced (10 to 40 units) in CIELAB space, and had decided that only colour differences on a relative visual scale of adjacent and separated colours would be considered. Two sets of data are now available and two more have been promised. Preliminary results suggest that CIELAB is better at describing these large colour differences as opposed to CIEDE2000. Further work is being conducted at BAM looking at threshold colour differences and further large sample differences.

### **TC1-64 Terminology for Vision, Colour and Appearance: Sharon McFadden CA**

The International Lighting Vocabulary has now been placed on the IEC website. This has forced the CIE to reconsider its method of publication of the ILV and it has been decided that the relevant sections of the publication will be placed on the CIE website as a searchable dictionary. As a result of this decision, a new process may be put in place for updating the vocabulary which may remove the requirement for TC1-64. The new process should be in place within the year.

### **TC1-65 Visual Appearance Measurement: Mike Pointer GB**

CIE Publication 175: 2006 A framework for the measurement of visual appearance has now been published. The TC also organised the successful Expert Symposium on

Appearance in Paris, France in 2006. The proceedings of this symposium will be published by CIE in July 2007.

Because the TC has completed its worked programme the national members present agreed that it be disbanded and consideration be given to a new TC to further the work on appearance.

#### **TC1-66 Indoor Daylight: Janos Schanda HU**

A TR has been approved within the TC that includes the following chapters:

- Ch.1. Introduction
- Ch.2. CIE illuminants and sources
- Ch.3. Need for (a) CIE Indoor Daylight Illuminant(s)
- Ch.4. Considering glazing transmission
  - 4.1 Average spectral transmission factor of window glass
  - 4.2 Selecting the thickness of the window glass to be considered
  - 4.3 Average angle of incidence of radiation
- Ch.5. Recommendation on Indoor Daylight Illuminant(s)
- Ch.6. Indoor daylight source
- Ch.7. Conclusions

A published paper is in preparation to provide the data that support the recommendations made in the TR that two indoor daylight Illuminants be specified as ID65 and ID50. No corresponding sources are recommended; this should form future work. It was also suggested that a new TC might investigate methods for the evaluation of simulators for ID50 and ID65 based on CIE Publication 51.

#### **TC1-68 Effect of Stimulus Size on Colour Appearance: Pete Bodrogi HU**

This TC met in Beijing. A comprehensive literature review has been carried out and some experimental work completed.

The colour appearance of a large (85° horizontal) homogeneous self-luminous visual stimulus has been studied. Large stimuli were displayed on a plasma panel display monitor and viewed for both 2 s and 8 s. These stimuli were compared with 2° (and 10°) standard-size stimuli presented on a grey background on a CRT monitor. The near-immersive colour stimulus was perceived to be lighter compared to the standard situation. Chromatic changes were also detected but they were not systematic.

In another study, the conspicuity of a coloured pattern was varied as a complex function of the size (area) and the hue and the apparent saturation and lightness of a surface colour found to increase with size (area).

In a third study comparing the "inherent" and the perceived colour of building facades, viewed in their existing surroundings, a consistent pattern of variation was found. The perceived facade colour was always less blackish than the "inherent" colour, and whitish colours tended to show increased whiteness, whereas more chromatic colours tended to become even more chromatic.

In a fourth study applying the colour perception of two-dimensional colour stimuli, e.g. computer screen images, it was shown that there were unexpected perceptual changes after application for real three-dimensional scenes (interiors and facades). In the real world, facades are generally not flat and they have textures and shadows as well. In this context, the perceived facade colours are subject to change.

Further studies are planned.

#### **TC1-69 Colour Rendering of White Light Sources: Wendy Davis US**

This TC met in Beijing and has agreed a work plan:

1. To agree on some basic criteria for a new metric (or system of metrics) such that it (or they) could be developed to be scientifically sound, acceptable to lighting industry, and useful.
2. To solicit, share, and discuss proposals for new assessment procedures for colour rendition properties of white light sources.
3. To evaluate proposed assessment procedures with visual experiments and compatibility with basic criteria (in #1).
4. To recommend a new metric (or system of metrics) based on evaluation (in #3).
5. To prepare a CIE Technical Report on recommended new metric (or system of metrics), including calculation procedures and justification for recommendation.

The TC now has 30 active members, ~6 interested observers and there were 47 attendees at TC meeting.

After discussion it was agreed that:

1. The new metric would assume that CRI may not exist in the future.
2. The new metric would have a one number output, with optional supplementary indices.
3. The new metric would be scaled to be ~comparable to CRI for traditional lamps, but acknowledge that the exact ordering of certain existing lamps may change.

It was agreed that colour fidelity would be an important component of new metric. The group was split as to whether other aspects of colour quality should be incorporated and so it decided to wait and see what the experiments said in terms of universality, etc. of these other dimensions.

A subgroup was formed to develop experiment guidelines to encourage others to contribute data.

Timeline:

- Two weeks: chair will send out a questionnaire on planned or current experiments.
- Three months: members will be required to return questionnaires with detailed experimental plans.
- Six months: light sources will be manufactured for experiments needing them; experimental guidelines subgroup will see where experiments can be made consistent and hence data inter-comparable.
- One year: conduct experiments.
- One year: evaluate data.

### **R1-32 Emotional Aspects of Colour: Gunilla Derefeldt SE**

The latest report is in the January 2007 Activity Report.

### **R1-39 Alternative Forms of the CIEDE2000 Colour-Difference Equations:**

**Mike Pointer GB**

#### **Introduction**

This Reportership was established to investigate the validity of the work reported in the paper entitled *A Lightness, Chroma and Hue Splitting Approach to CIEDE2000 Colour Differences* by J H Nobbs of the University of Leeds which showed that the four terms of the present formulation of the CIEDE2000 colour-difference equation could be re-worked into three terms. This reformulation has obvious advantages in many applications of the colour-difference formula, for example apportioning the colour difference into hue, chroma and lightness components for shade sorting and for attributing size and direction to a specific difference in recipe prediction.

#### **Protocol**

In order to investigate this reformulation of the equation a set of data was required

that conveniently sampled a reasonable volume of the XYZ colour space. The XYZ tristimulus values of the 2733 coloured Munsell samples were available and these provided such a sampling. These data were calculated using CIE illuminant SC and the CIE 2 degree observer. It is immaterial which illuminant/observer combination is used for the present analysis.

The data were transformed to CIELAB values using the conventional equations.

A model was then constructed to calculate a new triplet of  $L^*a^*b^*$  values such that the difference was  $x$  CIELAB colour difference units from each point in the tabulated data set. The direction of this difference was randomised in two dimensions, First a random angle was derived between  $0^\circ$  and  $360^\circ$  in the  $a^*b^*$  plane. Second a further random angle was derived having a value between  $+90^\circ$  and  $-90^\circ$  in the corresponding  $L^*C^*$  plane. These combined to provide a random point on a sphere of diameter  $x$  CIELAB units of colour difference centred on each of the tabulated points in the database.

Colour differences were then calculated using the CIEDE2000 formula and the corresponding revised formula.

In all cases the difference between the above two values of colour difference was found to be zero. This was found to be true for all values of  $x$  from 0 to 20 and higher, and for each time the programme was run, thus using different randomly selected angles.

### **Recommendation**

It seems reasonable that this reformulation of the equations that are used to derive the CIEDE2000 colour-difference formula should form an addendum to the present CIE publication 142:2001. The CIE Central Bureau has indicated that this is an acceptable way to deal with this matter. Publication 142 would be re-issued with a revised date, e.g. 142:2007.

It is not thought necessary to establish a Technical Committee to carry out this work, provided that this report is accepted by Division, National Committee and Board of Administration Ballot.

### **Note**

A spreadsheet has been written to carry out the above calculations and this can be made available to anyone who is interested.

1. J H Nobbs, Advances in Colour Science and Technology, Volume 5, Number 2, April 2002.
2. I am indebted to Dr Guihua Cui of the University of Leeds for providing the equations in a convenient form for inclusion in this work.

### **Discussion**

At the Division meeting there was some discussion as to an appropriate way to resolve this issue. Some agreed with the above proposal, others felt that there were other issues concerning CIEDE2000 that needed addressing. One other person wanted a purely mathematical proof of identity to be found. In view of the fact that an addition was required to CIE publication 142:2001 the consensus was that the modification should be sent to the National and BA ballot.

## **10. NEW WORK ITEMS**

### **R1-41 (C) Adaptation Transforms**

Terms of Reference:

To investigate and report, in one year, on the state-of-the-art of adaptation

transforms.

Boris Oicherman IL to be asked to do this work and report in one year.

Secretary's Note: Boris Oicherman has agreed to do this work.

#### **R1-42 (C) Extensions of CIECAM02**

Terms of Reference:

To evaluate potential additions to CIECAM02 in liaison with Division 8 and to include:

- Those published in the literature
- Extension to include unrelated colours
- Extension of the range down to scotopic levels

Changjun Li CN has agreed to be this reporter.

#### **R1-43 (V) Standard Deviate Observer**

Terms of Reference :

To document available databases that could yield a definition of a new standard deviate observer.

Boris Oicherman IL to be asked to take on this task and report in one year.

Secretary's Note: Boris Oicherman has agreed to do this work.

#### **R1-44 (V) Limits of Normal Colour Vision**

Terms of Reference:

To review the literature to see what information is available to establish the limits of normal colour vision.

Sharon McFadden agreed to do this in one year.

#### **R1-45 (V) Luminous Efficiency Functions**

Terms of Reference:

To provide definitions and tables of the existing functions  $V_{b,point}(\lambda)$ ,  $V_{b,2}(\lambda)$ , and  $V_{b,10}(\lambda)$ .

Yasuhisa Nakano JP agreed to complete this work within 6 months.

#### **TC1-70 (C) Metameric Samples for Indoor Daylight Evaluation**

Terms of Reference:

To investigate the derivation of a set of metameric samples to enable the evaluation of indoor daylight simulators

Chair: Dr Balázs Kranicz will be approached by Janos Schanda.

#### **TC1-71 (C) Tristimulus Integration**

Terms of Reference:

To investigate methods for computing weighting tables for the calculation of tristimulus values from abridged data.

Chair: Changjun Li CN

The following indicated that they were interested in membership: Michael Brill, Hugh Fairman, Alan Robertson, Byron Jordan. Bryan Rigg and Robert Seve should also be asked.

#### **Appearance**

In addition Mike Pointer presented a proposal to form a new TC to replace TC1-65

with the title Measurement of Appearance Network: MApNet

The suggested Terms of Reference were:

1. To establish a network of those interested in the measurement of visual appearance.
2. The network shall be under the direction and guidance of a group of at least four Technical Leaders each responsible for a particular aspect of the subject.
3. Each Technical Leader shall provide substantial periodic reports in a form that might be published.
4. A second Expert Symposium on Appearance shall be organised at an appropriate time within the next 4 years.
5. A database of relevant published work shall be maintained.
6. Consideration shall be given to the establishment of separate Technical Committees when appropriate

Janos Schanda indicated that the CIE Board were also giving consideration to the establishment of networks and so it was agreed that the Board would discuss this with the proposal of D1 in mind. Thus no decision was made to establish this TC.

Secretary's note: At the BA meeting on 12 July 2007, it was agreed that the above proposal was in line with the thinking of the Board and that this TC should be established. The Chairman will be Mike Pointer. And the committee is designated TC1-72 (C).

## **11. LIAISON REPORTS**

### **11.1 AIC: Paula Alessi**

The following meetings are planned:

Hangzhou, China: Colour Science for Industry, 12-14 July 2007

Alan Robertson is to be given the Judd AIC Award at this meeting.

See: [www.aic07.com](http://www.aic07.com)

Stockholm, Sweden: Colour: Effects and Affects, 15-18 June 2008.

See: [www.aic2008.org](http://www.aic2008.org)

Sydney, Australia: 11<sup>th</sup> AIC Congress 27 September – 2 October 2009.

See: [www.aic2009.org](http://www.aic2009.org)

### **11.2 ISO/TC38/SC1: Textiles: Colour Fastness & Measurement: Ronnie Luo GB**

Working to progress standards on:

CMCON02: colour inconstancy index

Standardising viewing cabinets using CRI and the Publication 51 method assessing daylight simulators.

Standardising the use of dyers' terms for describing colour difference: fuller/flatter, and brighter/duller.

### **11.3 ISO/TC42: Photography: Jack Holm US**

There is an extensive report in the January 2007 D1 Activity Report.

### **11.4 ISO/TC130: Graphic Technology: Danny Rich US**

No report.

### **11.5 ISO/TC6/WG3: Paper, Board and Pulp – Optical Properties**

The following recent activities may be of interest to the CIE:

In the past year, several ISO standards on optical properties of paper, pulp and board, have gone for ballot. These are:

- § Paper and board: Measurement of specular gloss – Part 1: 75 degree gloss with a converging beam, TAPPI method.
- § Paper – determination of light scattering and absorption coefficients using Kubelka-Munk theory.
- § Paper, board and pulp: Basic equations for optical property.
- § ISO/CD 5631 Paper and board – Determination of colour by diffuse reflectance: This standard has been issued in three parts:
  - § Part 1: Indoor daylight conditions (C/2 degrees)
  - § Part 2: Outdoor daylight conditions (D65/10 degrees)
  - § Part 3: Indoor illumination conditions (D50/2 degrees)
 This WG has indicated a need for a CIE normative reference for indoor and outdoor illumination conditions and the work being carried out in CIE TC 1-66, Chaired by Janos Schanda, has addressed this need by recently establishing recommendations for spectral power distributions for indoor daylight (ID65) and indoor illumination conditions for D50 (ID50). The WG has also indicated a need for a normative reference for the weighting tables for tristimulus calculations since colorimetric instrumentation for the paper industry typically uses a 10 or 20 nm measurement interval. At this time, ISO has received special permission from ASTM to include a copy of the relevant weighting tables from ASTM E308-99 for inclusion in each of the above ISO colour measurement standards. However, the WG would prefer to cite a CIE recommended method for computing these weighting tables for abridged tristimulus calculation.
- § The five authorized laboratories for ISO TC6/WG3 (known as the OPAL Group) met in Stockholm, Sweden, 11-12 June 2007. Some of the issues that were raised were: the need for a black level calibration procedure; and the geometric and bandpass correction procedures from 45/0 geometry, 5 nm bandpass standardizing laboratory calibration conditions to the d/0 geometry, 10 nm bandpass of ISO 2469 commercial instrumentation conditions.

## 11.6 ISO/IEC JTC1/SC28 Office Equipment: Klaus Richter DE Working Groups 1 of SC28 Office Systems

Draft proposal for organizational reform:

- Advisory Working Group
  - Develop a standardization strategy
  - Extract and find medium and long term standardization issues
  - Promote inter-organisational relationships
- Consumables Working Group
  - Yield (WG02)
  - Refills and remanufacturing cartridges
  - Environment – relating to consumables
- Hardware Process Working Group
  - Productivity (WG03)
  - Noise, safety and environment
  - Operability

## Working Groups 2 of SC28 Office Systems

Draft proposal for organizational reform:

- Image (quality) assessment
  - Image quality (WG04)
  - Test charts
  - Office Work Group – Office Colour Workflow
- Special Interest Group for colour comparison
  - Automated colour control

- Response to office viewing environment
- Office Work Group – Business Document Applications
  - Intelligent documents
  - Digital data and document formats
  - Document meta data
  - Network environment
  - Security
  - Operability (network related)

**Resolution 04 of the SC28 2006 Plenary Session**

Creation of a Special Interest Group (SIG) for colour comparison (scope in preparation): Contact Thomas Schmelzer

Resolution: SIG Colour Comparison SC28 resolves that the question of office equipment and how to manage successful visual colour comparison between prints and softcopy can be examined in SC28. SC28 agrees to consider the questions regarding, for example monitor and device calibration, encoded document colour information, adaptability to differing office conditions, and media colour information, to determine the potential for a set of specifications that can guide users and equipment manufacturers to improve the user experience with colour documents rendered in both softcopy and in print.

Note. There are two different areas of work identified for office colour prints and softcopy display. The question of illuminant belongs within the scope of CIE.

**Colour Standards with test charts produced by SC28 during 2003-07**

ISO/IEC TR17797:2004. Device output of 16-step colour scales, output linearization method (LM) and specification of the reproduction properties.

ISO/IEC TR24705:2005. Method of specifying image reproduction of colour devices by digital and analogue test charts.

ISO/IEC TR19752:2005. Method for the determination of toner cartridge yield for monochromatic electrophotographic printers and multi-function devices that contain printer components.

Other standards that measure yield with colour test charts are under preparation.

Yield question: how many pages can be printed by a set of consumables?

Productivity question: how many pages can be reproduced in a specified time?

**Test charts of ISO/IEC TR15775 and ISO/IEC TR24705**

Input	Output	Input media	Output media	Application	Technical Report
-	-	-	-	Basis	TR24705 DIN33866-1
Analogue	Analogue	Hardcopy	Hardcopy	Copier	TR15775 DIN3866-2
Analogue	Digital	Hardcopy	Data file	Scanner	TR24705 DIN3866-4
Digital	Analogue	Data file	Hardcopy Softcopy	Printer Monitor	TR24705 DIN3866-3 TR24705 DIN3866-5

**Additional remarks on colour topics related to CIE Division 1**

Conclusions of the 53rd meeting of ISO/TC 159/SC4/WG2 Visual display requirements, 19 May 2007, USA.

ISO TC159/SG4/WG2 Visual display requirements realizes that the colour spaces CIELAB and CIELUV of CIE Division 1 will soon become ISO/CIE standards. In applications we use these CIE colour spaces and device-dependent relative RGB

colour spaces. For users of visual display systems a device-independent RGB colour space is useful. This produces, via software, the elementary hues Red, Green and Blue for RGB data 100, 010 and 001, and equally spaced output in CIE colour spaces for equally spaced RGB input. We recommend that CIE Division 1 study the colorimetric definition of such a space, which can be used in visual display applications.

Remark. We have realized that an example of such a colour space is published in CIE x030:2006, p.139-144.

Action. White paper for discussion at CIE Division 1 technical meeting with title: Relative CIELAB data nce\* and rgb\* based on eight CIELAB reference colours.

#### **Next meeting of SC28 Groups**

01-Oct-2007 to 05-Oct-2007 at the Austrian Standards Institute, Vienna, Austria.

#### **6th BAM-DIN Workshop on Image Technology**

02-Dec-2007. See [www.ps.bam.de](http://www.ps.bam.de)

#### **11.7 ISO/TC159/WG2 Ergonomics: Ken Sagawa JP**

This work was reported during the discussion of TC1-54.

#### **11.8 International Association of Lighthouse Authorities: Ian Tutt GB**

No report.

#### **12. DIVISION OFFICERS**

The DD announced that the Division Officers would change after this meeting of CIE Division 1. Françoise Viénot had completed 16 years as Associate Director (Vision) and Yasuhisa Nakano had been Division Secretary since 1999. Both were presented with CIE Certificates to mark their retirement as CIE Officers. Sharon then introduced M Ronnier Luo as the next Director of Division 1.

Ronnie Luo announced that Dr Miyoshi Ayama had agreed to be the new Associate Director (Vision) and that Dr Ellen Carter, the current Division Editor, would be the new Associate Director (Colour). Mike Pointer, who had completed 12 years as AD(Colour) would be the new Division Secretary, and John Setchell from the US would be the new Division Editor.

#### **12. NEXT MEETING**

Possible venues for the next meeting of the Division in 2008 are:

Stockholm, Sweden: in conjunction with the AIC meeting: Colour Affects and Effects, 15-18 June.

Barcelona, Spain: in conjunction with the CGIV (Colour in Graphics, imaging and Vision) meeting 10-13 June.

In 2009 the CIE Interim meeting will be held in Budapest, Hungary. There is also the possibility to meet in association with the 11<sup>th</sup> AIC Congress in Sydney, Australia.

#### **13. ANY OTHER BUSINESS**

None.

#### **CLOSE OF MEETING**

The Director thanked everyone for attending, and the hosts for their organisation of the practical aspects of the meeting.

Dr Michael R Pointer  
Secretary – CIE Division 1

**ACTION LIST - SCIENCE**

<b>TC1-27</b>	Complete report	By December 2007	Paula Alessi
<b>TC1-37</b>	Complete first draft of Technical Report	By June 2008	Ken Sagawa
<b>TC1-42</b>	Complete first draft of Technical Report	By December 2007	Miyoshi Ayama
<b>TC1-44</b>	Complete Technical Report	By June 2008	Robert Hirschler
<b>TC1-57</b>	Complete CIELUV standard.	By December 2007	Alan Robertson
<b>TC1-57</b>	Write first draft of colour- difference standard	By December 2007	Alan Robertson
<b>TC1-58</b>	Complete Technical Report	By June 2008	Liisa Halonen
<b>TC1-61</b>	Agree contents of Technical Report and write first draft	By June 2008	Taiichiro Ishida
<b>TC1-67</b>	Complete first Technical Report	By June 2008	Hiroyasu Ujike
<b>TC1-69</b>	Agree planned experiments	By December 2007	Wendy Davis
<b>R1-19</b>	Review report	By December 2007	Officers
<b>R1-23</b>	Establish contact with Reporter	By June 2008	Miyoshi Ayama/ Françoise Viénot
<b>R1-35</b>	Obtain report	By January 2008	Miyoshi Ayama
<b>R1-36</b>	Write report	By December 2007	Judith Fekete
<b>R1-37</b>	Write report with TC proposal	By June 2008	Nina Itoh
<b>R1-39</b>	Ballot proposals	By December 2007	Mike Pointer
<b>R1-41</b>	Write report	By June 2008	Boris Oicherman
<b>R1-43</b>	Write report	By June 2008	Boris Oicherman
<b>R1-44</b>	Write report	By June 2008	Sharon McFadden
<b>TC1-70</b>	Establish TC membership	By June 2008	Balázs Kranicz
<b>TC1-71</b>	Establish TC membership	By June 2008	Changjun Li
<b>TC1-72</b>	Establish subject leaders	By December 2008	Mike Pointer
<b>TC1-72</b>	Establish network	By June 2008	Mike Pointer

**ACTION LIST - BUSINESS**

Compile Division Mailing Lists	By September 2007	Division Secretary
Distribute Beijing Minutes	By October 2007	Division Secretary
Produce Activity Report	By February 2008	Division Editor
Organise next Division Meeting	By June 2008	Division Officers

## APPENDIX 1

# CIE DIVISION 1 "VISION AND COLOUR" Fourth Meeting of the McFadden Term 10 July 2007

## AGENDA

### Tuesday 10 July

#### 9:00 – 10:00 **General Opening Session**

1. Opening and welcome by Director, Ms. Sharon McFadden
2. Announcements
3. Attendance
4. Membership
5. Discussion and confirmation of agenda
6. Approval of the minutes of the 3<sup>rd</sup> meeting of the McFadden term
7. Matters arising from these minutes
8. Director's report, including report from CIE Board of Administration
9. Reports from Editor and Secretary, E. Carter and Y. Nakano

10:00 – 10:30 Break

#### 10:30 – 17:00 **CIE Division 1 Business Session**

10:30 – 12:15 10. Report of Vision Section and Discussion  
Dr. Françoise Viénot

12:15 – 13:30 Lunch

13:30 – 15:15 11. Report of Color Section and Discussion  
Dr. Mike Pointer

15:15 – 15:30 Break

15:30 – 16:30 12. Discussion on new work item proposals  
- new TCs and Reporters

16:30 – 16:45 13. Liaison

16:45 – 16:50 14. New executive

16:50 – 17:00 15. Next meeting

Close