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

ACTIVITY REPORT
DIVISION 1
VISION AND COLOR

January 2006

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This report represents an overview of the status of CIE Division 1 - Vision and Color since the last activity report that was issued in January 2006.

The annual meeting of Division 1 was held May 19th 2006 in Ottawa, Canada. The Division 1 Meeting was held in conjunction with the Division 1 Expert Symposium: 75 Years of the CIE Standard Colorimetric Observer and also the Inter-Society Color Council met at that time. Over 80 people attended the Symposium which included 27 papers and 5 posters. The papers covered the history of, present research on, and the future for the 1931 Colorimetric Observer. The Division meeting was attended by 5 officers, 12 country representatives from the 37 member nations and many guests (30 people in total attended). Seven Technical Committees (TCs) met in conjunction with the meeting: TC1-42 Colour Appearance in Peripheral Vision, TC1-57 Standards in Colorimetry, TC1-58 Visual performance in the mesopic range, TC1-60 Contrast sensitivity function for detection and discrimination, TC1-63 Validity of the Range of CIEDE2000, TC1-66 Indoor Daylight Illuminant, and TC1-67 The Effects of Dynamic and Stereo Visual Images on Human Health.

A second very successful Division 1 Symposium, organized by TC1-65, Measurement of Visual Appearance, was held on 19-20 October, in Paris, France. It had over 110 attendees and included 22 papers and 22 posters. The Proceedings will be available from the Central

Bureau. TC1-67 The Effects of Dynamic and Stereo Visual Images on Human Health also met in conjunction with this symposium.

At the CIE Quadrennial Meeting in Beijing, a new Director and two new Associate Directors will take on the task of guiding the work of Division 1 for the next four years. The incoming Directors are:

Division Director: Dr. Ronnier Luo (UK)
Associate Director – Vision: Dr. Miyoshi Ayama (JP)
Associate Director – Colour: Dr. Ellen Carter (US)

A summary of the status of each of the committees in Division 1 - Vision and Color is included in this report. The Reporterships and Liaison activities of Division 1 are also included. The order is first all the technical committees and reporterships of the Vision Section are presented. Then the technical committees and reporterships of the Color Section are presented. Next the Liaison reports are included. Finally, the recent publications are listed.

VISION SECTION

Active Technical Committees

TC1-30 (V) Luminous Efficiency Functions

Year Established: 1990

Terms of Reference:
To prepare a Technical Report on luminous efficiency functions which classifies and specifies the existing functions $V_{b,point}(\lambda)$, $V(\lambda)$, $V_{b,2}(\lambda)$, $V_M(\lambda)$ and $V_{b,10}(\lambda)$, and the color matching function $\bar{y}_{10}(\lambda)$ if appropriate, in their photometric use.

Chairman: Y Nakano JP

Members: M Ikeda JP, P K Kaiser CA, JA Kinney US, S Kokoschka DE, P Trezona GB, K Sagawa JP, H Yaguchi JP, F Viénot FR

Report:
No report.

TC1-36 (V) Fundamental Chromaticity Diagram with Physiologically Significant Axes

Year Established: 1991

Terms of Reference:
To establish a chromaticity diagram of which the coordinates correspond to physiologically significant axes.

Chairman: F Viénot FR

Members: P Lennie US, D MacLeod US, J D Mollon GB, J D Moreland GB, Y Nakano JP, J Pokorny US, L T Sharpe DE, A Stockman US, A Valberg NO, J J Vos NL, and P L Walraven NL

Consultants: H Scheibner DE, P Trezona GB, and H Yaguchi JP

Working Program:
Write a report with a clear statement on the choice of a set of color-matching functions and estimates of cone fundamentals for the normal observer. The committee will take into account the variability among normal and dichromatic observers.

1. Agreement should be reached on the following points:
   a. Choice of a set of color-matching functions and evaluation of the consequence of this choice, compared to other possibilities.
   b. Accordance with the 1988 $V_M(\lambda)$ luminous efficiency function.
   c. Data on ocular media and macular pigment.
   d. Use of Konig fundamentals. (Identity of the copunctal points with the fundamentals.)
   e. None or little participation of S cones to luminance. If any, evaluation of the luminance discrepancy between a constant (L+M) diagram and a constant-luminance diagram.
2. Establish a chromaticity diagram.
3. Prospect the construction of a color space with significant axes. Basic stimuli and scaling of the axes should be discussed. Reference the literature where such color spaces are used in order to list the topics relevant to this color space.

Report:
Publication CIE 170-1:2006 Fundamental Chromaticity Diagram with Physiological Axes - Part 1 was issued in 2006. The TC is now working on Chapter 7 of Part II, dealing with photometry, in order to propose 2-dimensional diagrams.

TC1-37 (V) Supplementary System of Photometry

Year Established: 1992

Terms of Reference:
To recommend a system of photometry to assess lights in terms of their comparative brightness relationships at any level.

Chairman: K Sagawa JP

Members: S Ashizawa JP, W B Cowan CA, C M Howard US, M Ikeda JP, J A S Kinney US, S Kokoschka DE, Y Nakano JP, D Piao CH, T Takeuchi JP, J Taylor GB, P W Trezona GB, F Viénot FR, H Yaguchi JP, and A Yujiri JP. Also, H J Schmidt-Clausen DE (Observer)

Working Program:
1. To list items on which photometric systems based on brightness matching are evaluated, such as the reference stimulus, linkage to the current CIE photometric and colorimetric systems, practical simplicity and the physiological basis of the system structure, etc. The numerical testing results from TC1-21 are to be included.
2. To evaluate the proposed systems according the items listed above.
3. To recommend a system from the proposed systems, or by some combination of them.
4. To prepare a report on the recommendation of a supplementary system of photometry.

Report:
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 art, etc, concerning the development of a CIE Supplementary System of Photometry. Based on this article, a CIE technical report is currently being prepared.

TC1-41 (V) Extension of $V_M(\lambda)$ Beyond 830 nm

Year Established: 1993

Terms of Reference:
To write a report on the feasibility of the extension of $V_M(\lambda)$ beyond 830 nm, including modification of $V_M(\lambda)$ in the 660-780 nm region of the spectrum.

Chairman: P L Walraven NL

Members: D H Sliney US and J J Vos NL

Report:
No report.

TC 1-42 (V) Color Appearance in Peripheral Vision

Year Established: 1993

Terms of Reference:
To prepare a technical report on color appearance zones for colored lights in terms of unique hues in peripheral vision.

Chairman: M Ayama JP

Members: I Abramov US, H Chan US, G Derefeldt SE, L Eriksson SE, J Gorden US, S McFadden CA, K Okajima JP, S Otake JP, M.Pointer GB, M Takase JP, and A Yujiri JP

Report:
The committee had a meeting at the CIE Expert Symposium on May 18, 2006, held in Ottawa, Canada. In the meeting, Ayama presented the revised proposal for the contents of the Technical Report, and it was basically approved by the members who attended the TC meeting and the other attendees. A tentative plan of the chief writer(s) for each chapter was determined. Positive action for making the TC-Report is desired. The chairman wants to have a TC meeting in Beijing, 2007.

TC1-54 (V) Age-Related Change of Visual Responses

Year Established: 1999

Terms of Reference:
To establish luminous efficiency, visual acuity, and contrast sensitivity as a function of age.

Chairman: K Sagawa JP

Members: H Bouma NL, L Halonen FI, W Iwai JP, D Kline CA, I Kucsera HU, A Monot FR, R Topalova CA, and J Werner US

Working Program:
1. To survey relevant data in the literature and ongoing studies as well for establishing data bases for the age-related change in spectral luminous efficiency, visual acuity, and contrast sensitivity functions.
2. To establish fundamental data bases for those functions as a function of age.
3. Write a report with those databases.

Report:
For the CIE BA the Chairman has been developing a guideline of lighting for the elderly and the disabled persons. TC 1-54 has joined in this work, and the data collected so far in the TC is being adopted in the draft version of the guideline. 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 final draft of the guideline will be finished by the CIE Session 2007 in Beijing with the aim that the document will be completed within the calendar year of 2007.

TC1- 58 (V) Visual Performance in the Mesopic Range

Year Established: 2000

Terms of Reference:
To define mesopic visual performance and related terms.
To investigate performance based photometry in the luminance region below approximately 10 cd/m^2.
To propose a model for the basis of performance based mesopic photometry.

Chairman: L Halonen FI

Members: M Eloholma FI (Sercretary). M Ayama JP, P Bodrogi HU, E C Burini Jr BR, D Chen CN, D L Crawford US, O DaPos IT, G Derefeldt SE, K ChangSoon, KR, DL Crawford US, N Itoh JP, C S Kim KR, C Knight, L Leetzow, US, I Lewin US, Y Lin CN, S McFadden CA, M Nicholson GB, M Pointer GB, K Sagawa JP, J Schanda HU, W Simpson CA, F Viénot FR, S Völker DE, A Wang CN, and E Yandek GB

Report:
The third meeting of TC 1-58 was held in Ottawa Canada in May 2006 along with the ISCC/CIE Expert Symposium '75 Years of the CIE Standard Colorimetric Observer. The meeting gathered 17 participants. The meeting was effective and included good discussions on the topic.

Two surveys have been carried out to outline the current knowledge and ongoing research activities in the mesopic field. There are several interesting research projects and PhD research going on in the mesopic field world-wide. The survey results were discussed. The TC decided not to make the TC work too wide and to use the data of the second survey in defining the relevant visual tasks and parameters of mesopic applications.

Experiments have been done on reaction time and contrast threshold and these new data sets have been applied to the X-and MOVE-models. Further new data sets with different parameters will be generated to validate the existing models. All TC members are encouraged to generate new data for testing and analyzing the existing performance based mesopic models.

The objective of the TC is to come to propose a model for performance based mesopic photometry by June 2008.

The TC1-58 web-site at: http://www.lightinglab.fi/TC1-58 has been updated. There are currently 25 TC members.

TC1-60 (V) Contrast Sensitivity Function (CSF) for Detection and Discrimination

Year Established: 2001

Terms of Reference:
To specify a baseline achromatic CSF with its reference conditions and reference observer and to specify CSF extensions based on discrimination thresholds, as well as chromatic CSFs for both detection and discrimination.

Chairman: E. Martinez-Uriegas, ES

Members: D Alleyson FR**,** J M. Artigas Verdes ES, T Carney, US, C-C Chen, US, M Fairchild US, R V Klassen US, L MacDonald GB, S McFadden CA, L Mohamed-Chaker FR, E Peli US, S Wuerger HU, and H Yaguchi JP.

Observers: P Hanselaer, K Sagawa, N Itoh, L Beke, D Couzin, K Richter, M H Brill, O DaPos

Report:
From the Ottawa meetings, we redefined tasks and assignments as follows:

- Introduction/philosophy of the approach of the technical report. Under discussion: Beau Watson (s), Mark Fairchild (s), Eli Peli (s), Eugenio Martinez-Uriegas

- Search for data and conditions: Sharon McFadden, Chaker Larabi, David Alleysson (s), Jose M. Artigas (s), Chein-Chung Chen (s)

- Preparing tables of data and conditions: Sharon McFadden, Lindsay McDonald (s), Hirohisa Yaguchi (s), Sophie Wuerger (s)

- Combining data sets – analysis and review of data: Victor Klassen, Beau Watson (s), Eli Peli (s), Thom Carney (s)

- Organize regular teleconferences/e-Room reviews and combine all inputs to update and circulate our technical report draft: Eugenio Martinez-Uriegas

We are currently circulating the second draft of TC1-60 Technical Report and working on the third (hopefully final) draft.

TC1-67 (V) The Effects of Dynamic and Stereo Visual Images on Human Health

Year Established: 2005

Terms of Reference:
To write a technical report on the physiological and psychophysical effects of dynamic and stereo visual images in terms of photosensitive seizures, visually induced motion sickness and eyestrain.

Chairman: H Ujike (JP)

Members: members are being sought.

Report:
This TC was formed at the Division 1 meeting in León, Spain in May 2005, however, there has bee no report since then.

Vision Reporterships

R1-19 (V) Specification on Individual Variation in Heterochromatic Brightness Matching: H Yaguchi JP

Year Established: 1997

Terms of Reference:
To report on the possibility to develop a simple test of individual characteristics for heterochromatic brightness matching.

Report:
The reporter is preparing a report on heterochromatic brightness matching in terms of individual difference with the possibility of developing a simple test of individual characteristics for heterochromatic brightness matching. The report will be delivered before the next Division meeting in Beijing.

R1-23 (V) Guidelines on Planning a Mesopic Photometry Investigation:

P Trezona GB

Year Established: 1999

Terms of Reference:
With several new mesopic photometry investigations being contemplated, the impact of theory of other considerations on the experimental design will be reported.

Report:
No update.

R1-35 (V) Irregularities in $\bar{y}_{10}(\lambda)$: P Walraven NL

Year Established: 2004

Terms of Reference:
To document the irregularities in $\bar{y}_{10}(\lambda)$ and, if necessary, to recommend the formation of a Technical Committee to consider possible modifications.

Report:
No update.

R1-36 (V) Action Spectra for Glare: J Fekete HU

Year Established: 2004

Terms of Reference:
To summarize the literature on the subject and make recommendation for terms of reference for a technical committee.

Report:
There were no publications about action spectra for glare this year.

R1-37 (V) Definition of the Visual Field for Conspicuity: N Itoh JP

Year Established: 2004

Terms of Reference: To summarize the literature on the Visual Field for conspicuity and make a recommendation for terms of reference for a Technical Committee.

Report:
No update.

R1-38 (V) Concept and Application of Equivalent Luminance: Y. Nakano JP

Year Established: 2005

Terms of Reference:
The reporter is to prepare a report addressing this topic.

Report:
This reportership was formed when TC 1-46 was closed during the meeting of Division 1 in León Spain in May 2005, however, there has been no update since that time.

R1-40 (V) Scene Dynamic Range: J. Holm US

Year Established: 2006

To investigate the concept of scene dynamic range, the appearance of colors brighter than the adapted white, and adaptation to the dynamic range when viewing, and make recommendations regarding work to be done by the CIE.

Report:
This reportership was formed at the Division 1 meeting in Ottawa in May 2006.

Holms reports that basically, there seem to be three areas of potential activity: 1. A review of the literature to see what information is available; 2. Compilation of a database of measurements of real (and possibly computer generated) scene dynamic range data; and 3. Identification and recording of fundamental issues relating to scene dynamic range.

Concerning the first item, I have been collecting papers and books, but I haven't yet had a lot of time to review the collection. I have made a few preliminary observations which are reported in relation to area 3.

Concerning the second item, I am continuing to capture scenes using well-characterized digital cameras, to generate scene-referred images. I am also involved in scene referred image generation and collection activities in ISO TC130 (PWI 12640-5) and in the Academy of Motion Picture Arts & Sciences. I will check to see whether it is acceptable to

report dynamic range statistics on these images as well as for those I collect myself. I also remain interested in scene-referred images from other well-characterized sources.

Concerning the third item, there are a few preliminary findings to report. The first is that, while there is no agreed definition for “high dynamic range” images, the most consistent meaning seems to be images that contain colors above diffuse white. This results in the adopted white concept (as defined in ISO 22028-1) being important to this investigation. However, methods for selection of the adopted white for a scene do not seem to be well understood.

The problem is that, in practice, most color science work is performed using reasonable, even illumination of a two dimensional surface oriented perpendicular to the axis of viewing. In this circumstance the adopted white is clear – the spectral power distribution of a perfect reflecting diffuser in the surface plane, illuminated by the illumination source. However, real scenes are typically three-dimensional, consist of reflecting, transmitting, scattering, fluorescent and emitting objects oriented at various angles, and often the overall illumination is not even. This makes the selection of the adopted white much more ambiguous. There are also situations where the viewing illumination is not fully adapted to, or the adaptation varies over the scene. There are two dimensions to this variation, chromaticity and luminance.

In the motion picture industry, it is common practice to work relative to an “adopted midtone gray” which fulfills a similar role to an adopted white, except it is a perceptual neutral midtone as opposed to a perceptual diffuse white. There are also other whites of importance, such as the “edge of detail white” and the “saturation/clipping white.” Also important are “edge of detail black” and “clipping black.” I have found it convenient to borrow from Adams and refer to these using zone numbers, as follows: Z0 = clipping black, Z1 = edge of detail black, Z5 = adopted midtone gray, Z9 = edge of detail white, and Z10 = clipping white.

The adopted (diffuse) white varies quite a bit in relation to these other tones. For example, in a scene with a great deal of above diffuse white colors, the adopted white may be placed only a little above a middle gray. In another scene with no light content, the adopted white may be placed higher than the clipping white. Also, the relationship of all these “zones” to each other varies significantly from scene to scene.

In photographic and cinematographic applications, the placement of the adopted white can also depend on the color rendering transform to be applied to produce the reproduction. For example, a color rendering transform that contains a lot of highlight compression may result in the selection of a lower luminance adopted white than one with minimal highlight compression.

In summary, it seems to be more straightforward to define dynamic range in terms of Z9/Z1 or Z10/Z0, but to make color science results more applicable to imaging there is also a need to get a handle on the ratios of the adopted white to the zone values.

Comments and feedback on this report would be appreciated.

COLOR SECTION

Active Technical Committees

TC1-27 (C) Specification of Color Appearance for Reflective Media and Self-Luminous Display Comparison

Year Established: 1990

Terms of Reference:
To study and make recommendations for the specification of a color appearance match between a reflective image and a self-luminous display image.

Chairman: P J Alessi US

Members: T F Chong HK, G Derefeldt SE, M Fairchild US, T Fuchida JP, A Hanson GB, M Ikeda JP, E Khoury FR, V Kojtcheva BU, M R Luo GB, D Rich US, K Richter DE, A R Robertson CA, T Suzuki JP, and J Walraven NL.

Consultants: R W G Hunt GB, Y Nayatani JP, and M R Pointer GB.

Working Program:
1. Investigate whether the CIELUV and CIELAB color spaces adequately specify a color appearance match between a reflective image and a self-luminous display image.
2. Investigate whether modifications to the CIELUV and CIELAB equations (such as white point color stimulus specification) would be adequate to specify a color appearance match between a reflective image and a self-luminous display image.
3. Investigate the use of the Hunt and Nayatani color appearance models to specify a color appearance between a reflective image and a self-luminous display image.

Report:
The final report is being written and will be completed by the Beijing meeting.

TC1-38 (C) Compatibility of Tabular Data for Computational Purposes

Year Established: 1992

Terms of Reference:
To prepare guidelines for tabulating CIE spectral data to provide compatibility of sets of data for computational purposes, considering such factors as spectral range, spectral interval, function, truncations, interpolation, extrapolation and number of digits.

Chairman: M R Pointer GB

Members: F W Billmeyer* US, J Campos ES, H Fairman US, R W G Hunt GB, T Kehlibarov BU, C McCamy US, K Okubo JP, D C Rich US, A R Robertson CA, J Schanda, HU, R Sève FR, H Tersteige* DE, J Verrill* GB, K Witt DE and J C Zwinkels CA
[* - deceased]

Report:
With the publication of CIE Publication 167:2005: Recommended practice for tabulating spectral data for use in colour computations, the work of this TC is now complete. This TC was formally disbanded at the Division 1 meeting in Ottawa in 2006.

TC1-44 (C) Practical Daylight Sources for Colorimetry

Year Established: 1995

Terms of Reference:
1. To compare existing daylight simulators for color measuring instruments and color matching booths
2. On the basis of this intercomparison, to recommend practical methods for simulating daylight sources.

Chairman: R. Hirschler HU

Members: A Bristow SE, P Chong US, W Czepluch DE, D Hinks US, H Fairman US, R Hunt GB, T Kehlibarov BU, T Ichijo JP, J van Kemenade NL, H Lara US, M R Luo GB, C McCamy US, M Pointer GB, Y Ohno US, B Powell AU, C Puebla DE, M L Rastello IT, A Rodrigues US, J Schanda HU, K Witt DE, R Young US, and J Zwinkels CA

Consultants: P Bradfield US, G Dakin GB, R Harold US, C Hughes US, K Imura JP, N Lena US, G Lorditch US, D Rich US, R Schiele US, and H Stepper US

Working Program:
1. Obtain spectral irradiance data on existing simulators for both color-matching booths and color measuring instruments, either directly from the manufacturer or from spectroradiometric measurements performed by the committee members, under standardized conditions.
2. Evaluate the performance of these existing simulators according to various criteria, including: 1.) quality of simulation based on CIE Publication no.51; 2.) integrity of simulation (e.g. stability, insensitivity to instrument geometry and polarization effects, optical throughput); 3.) practicality of implementation (e.g. simplicity of fabrication, economy, compatibility with existing instrumentation)
3. Prepare a CIE technical report on these findings and provide recommendations for practical methods of simulating daylight sources for different applications (e.g. based on allowable color-difference errors). It is expected that more than one method will be

required to satisfy practical considerations. This is likely because, for example, it is not possible to have as stable or reproducible a daylight simulation with pulsed lamps as continuum lamps, but they are preferred for on-line measurements; so this reality must be accommodated in the recommendations.

Report:
The first draft of the Technical Report for this TC is ready to be distributed (in January 2007) for TC members and consultants. It lists the currently available technologies for daylight simulators used for visual assessment and in color measuring instruments (filtered incandescent lamps; dichroic lamps; filtered xenon short arc and flash lamps and LED sources). It also describes standard methods for the evaluation of daylight simulators and the most important national and international standards for the classification of daylight simulators.

TC1-55 (C) Uniform Color Space for Industrial Color Difference Evaluation

Year Established: 1999

Terms of Reference:
To devise a new uniform color space for industrial color-difference evaluation using existing experimental data.

Chairman: M Melgosa ES

Members: D Alman US, R Berns US, E Carter US, G Cui GB, M D Fairchild US, R Kuehni US, M R Luo GB, J Nobbs GB, C Oleari IT, M R Pointer GB, D Rich US, K Richter DE, B Rigg (GB), A R Robertson CA, J Romero ES, G Rösler DE, M Vik CZ, K Witt DE, J H Xin CN, and H Yaguchi JP

Advisor: R Huertas ES

Report:
During 2006 three interesting reports have been produced by members of this Technical Committee (TC), communicating their thoughts about the goals and procedures to be followed by our TC. These reports were shared and discussed by email among TC members. On June 19, 2006, a TC meeting was held in Leeds, United Kingdom with 11 members in attendance. The main conclusions of this meeting were as follows: 1) to add Dr. Gerhard Röesler (Germany) as a new TC 1-55 member; 2) to prepare a TC website containing general information and experimental datasets to be used for model development and testing; 3) to request new experimental datasets on color differences, to be added to those employed for the development of the CIEDE2000 formula, through a note published in the journal *Color Research and Application*; 4) to look for a Euclidean alternative space to CIELAB using available data only, from the point of view of improved color-difference evaluation.

Following that meeting the request for data sets was prepared and has been submitted to *Color Research and Application.* It will be published in early 2007.

TC1-56 (C) Improved Color Matching Functions

Year Established: 1999

Terms of Reference:
1. To compare results based on the current CIE color matching functions, color matching functions proposed by Dr. W. Thornton's laboratory, and those of CIE TC1-36.
2. To initiate experiments to obtain data for such comparison in different laboratories.
3. To report to CIE Division 1 on the results of the above investigation and make an eventual recommendation for future CIE color matching functions.
4. To report to CIE Division 1 an eventual recommendation for the use of the new color matching functions in specifying color spaces and color-difference formulas.

Chairman: M Brill US

Members: M Fairchild US, H Fairman US, K Houser US, R Kuehni US, R Luo UK, Y Nakano JP, B Oicherman GB, C. Oleari IT, D Oulton GB, D Rich US, A R Robertson CA, J Schanda HU, A Stockman US, A Tarrant UK, *W A Thornton US, P W Trezona GB, J H Wold NO, K Wenzel HU, and J Zoido ES
* deceased

Report:
The year 2006 has featured quiet individual work but no official meetings for TC1-56.

We have lost a very important member of TC1-56: Dr. William A. Thornton, whose work stimulated the entire effort of the TC. An obituary appears in *Color Research and Application*, December 2006. He will be missed.

At the CIE Expert Symposium in Ottawa, I presented a paper summarizing the state of TC1-56. The paper was based on a chapter called "Open Problems on the Validity of Grassmann's Laws" coauthored with Alan Robertson: "CIE Colorimetry: Understanding the CIE System" (ed. by Janos Schanda) to be published by Wiley in 2007. At the Expert Symposium, a suggestion was made to investigate the limits of Grassmann additivity without the added complication of transformability of primaries. This might be a useful interim goal if the transformability studies prove too intractable. But we should not abandon the transformability issue, and especially not lose track of intra-observer data averaging.

I will send a committee mailing out in the near future. The target date for completion of TC1-56 is 2009.

TC1-57 (C) Standards in Colorimetry

Year Established: 2000

Terms of Reference:
To prepare a series of CIE/ISO/IEC Standard(s) that describe:
1. The method of calculating CIE tristimulus values and chromaticity coordinates
2. A uniform color space and its associated metrics
3. A formula for industrial color difference evaluation.

Chairman: A R Robertson CA

Members: A Bristow SE, J Campos Acosta ES, R Connelly US, J F Decarreau FR, R Harold US, R Hirschler HU, H Ikeda JP, C. Kim KR, D McDowell US, P McGinley AU, Y Ohno US, M Pointer GB, K Richter DE, G Rösler DE, J Schanda HU, R Sève FR, K Witt DE, H Yaguchi JP, and J Zwinkels CA

Liaison members:
IEC TC100/TA2, H Ikeda; ISO TC 6, A Bristow; ISO TC35/SC9/WG22, G Rösler; ISO TC38/SC1/WG7(UK), M Pointer; ISO TC38/SC1/WG7 (US), R Harold; ISO TC42, D. McDowell; ISO TC130, D. McDowell; ISO/IEC/JTC1/SC28, K Richter

Report:
D1 and BA ballots on the CIELAB Standard have been completed. The D1 result was 9 in favor, 0 against and 0 abstentions. The BA result was 8 in favor, 0 against and 1 abstention. A few editorial comments have been resolved and the latest draft (DS 014-4.2/E:2006) is now with the CIE National Committees for comments with a deadline of 2007-03-15. The lessons learned in preparing this standard are being applied to the development of the standards on CIELUV (DS 014-5), the calculation of tristimulus values (DS 014-3), and CIEDE2000 (DS 014-6).

The first draft of the CIELUV Standard has been discussed and the main issue was whether the Standard was needed at all. All were agreed that a Standard on the u',v' diagram was needed but opinions differed on whether the full CIELUV space and color-difference formula should become a Standard. Some felt that to propose two spaces (CIELAB and CIELUV) as Standards would be confusing. Others felt that, because CIELUV was still sometimes used, it should be written as a Standard. On the basis that the purpose of the Standard(s) was not to say "you must use this uniform space" but rather to say "if you choose to use this space, this is the correct way to do it," it was agreed that work on the full CIELUV Standard should proceed. The Chair will write a second draft for review by the ISO and IEC Committees with which TC 1-57 has liaisons.

A meeting of the TC was held in Ottawa on 2006-05-18 with 8 members and 21 guests in attendance.

TC1- 61 (C) Categorical Color Identification

Year Established: 2001

Terms of Reference:
To prepare a report describing a color categorization map for the photopic and mesopic illumination levels.

Chairman: T Ishida JP

Members: O Da Pos IT, N Johnson US, M R Luo GB, K Okajima JP, M Pointer GB, L Ronchi IT, K Sagawa JP, J Schanda HU, H Shinoda JP, and H Yaguchi JP

Report:
This TC has not been active in 2006. The chair is planning to have the TC meeting at CIE Session 2007 in China and is preparing the first draft document.

TC1- 62 (C) Color Rendering of LED Light Sources

Year Established: 2002

Terms of Reference:
To investigate by visual experiments color rendering properties of white LED light sources and to test the applicability of the CIE color rendering index to white LEDs.

Chairman: P Bodrogi, HU

Members: P Alessi US, I Ashdown CA, P Csuti HU, W Davis US, L Halonen FIN, G Heidel DE, R Hirschler HU, F-C Hwang TW, A D Jackson US, C S Kim KR, K Kohmoto JP, B Kránicz HU, Y Kwak KR, C Li CN, M R Luo GB, K Muray US, Y Nakano JP, Y Ohno US, K Oshima JP, M Pointer GB, E Radkov US, D Rich US, N Sándor HU, J Schanda HU, R Stolyarevskaya RU, J van Kemenade NL, R Stolyarevskaya RU, F Viénot FR, S Weintraub US, H Yaguchi JP, T Yano JP, and R Young US.

Advisors: O da Pos IT, A de Visser NL and F Viénot FR

Report:
The Technical Committee has submitted a draft Technical Report on “Colour rendering of white LED light sources” to the CIE Central Bureau. The draft report was circulated for Division and Board ballot and has now been published as CIE 177:2007: Colour rendering of white LED light sources.

TC1- 63 (C) Validity of the Range of CIEDE2000

Year Established: 2003

Terms of Reference:
To investigate the application of the CIEDE2000 equation at threshold, and to CIELAB color differences greater than 5 units.

Chairman: K Richter, DE

Members: K R Gegenfurtner DE, T Holtsmark NO, M R Luo GB, M Melgosa ES, J Nobbs GB, C Oleari IT, M Pointer GB, D Rich US, J Schanda HU, P Walraven NL, and H Yaguchi JP

Report:
In was intended to repeat the 2005 results of the research project for large color differences between both white and black and the three primary and three secondary colors of offset printing at different places, see the former results at the URL <http://www.ps.bam.de/CIE63.

In 2006, members of four countries agreed to produce new experimental data during 2007 with the same original test charts, which have been delivered for free. Only relative color differences on a relative visual scale of adjacent and separated colors are under study. The URL http://www.ps.bam.de/ME25/10L/L25E00NP.PDF includes a visual representation of one test charts. The questionnaire to fill out is on page 2 of the file output.

Also in 2006, the chairman reported the preliminary results at two meetings of TC1-63 in Ottawa (CA) and in Leeds (GB). A Relative Color Difference Index (RCDI), which is zero in the case of no difference between the visual and the calculated color difference, produces the following values for the different CIE color difference formulas: CIELAB: 0.041; CIELUV: 0.059; CIE94: 0.074; CIEDE2000: 0.090. According to this preliminary result for large color differences (range 10 to 40 CIELAB), the formula CIELAB is about twice as good as CIEDE2000.

Ronnier Luo presented at the two TC1-63 meetings experimental results of both small and larger color differences up to 10 CIELAB. According to his results there was a similar tendency for larger differences. For small color differences up to five CIELAB units, the formula CIEDE2000 was much better compared to CIELAB, but with increasing color differences (only up to 10 CIELAB) the improvement decreased. Therefore this result seems to be in agreement with the above preliminary results. There may be two different color metrics necessary for adjacent colors and/or small differences (application of CIEDE2000 for small industrial tolerances) and separated colors and/or large differences (application of CIELAB in image technology with large differences).

For sample differences near threshold and for large differences of both adjacent and separated samples a new research project has been started in 2005. Visual experiments with 30 observers and the above four cases along the lightness axis and perpendicular in red-green and yellow-blue direction for about 30 achromatic and chromatic colors are finished and will be analyzed in 2007.

Two papers by the chairman, which produce and combine two different color metrics for adjacent and separated samples of achromatic and chromatic, are at the URL's

<http://www.ps.bam.de/BAMAT.PDF> and <http://www.ps.bam.de/VISE06.PDF>. For achromatic colors the first paper helps to understand the differences by combining the Weber law at color threshold and the Stevens law for color scaling by two color metrics.

For chromatic colors the second paper helps to understand the visual (signal) differences for adjacent colors and separated colors. It starts with LMS cone sensitivities and produces a color space LMSLAB that has cone excitation diagrams similar to the (a', b') cube root chromaticity diagram proposed for CIELAB, see Richter in CR&A 1980:**5**: 25-42. In 2007 another paper on this topic will be given at the next CIE meeting in Bejing.

A model which combines the two color metrics for both adjacent and separated samples and additionally describes the color attributes elementary hue and relative blackness is important for the area of image technology, see Richter in CIE x030:2006, p. 151-156.

TC1- 64 (C) Terminology for vision, color, and appearance

Year Established: 2003

Terms of Reference:
To monitor the terminology requirements of Division 1 including the revision of the present ILV terms and the addition of new terms.

Chairman: S. McFadden, CA

Members: E Carter (US), O Da Pos (IT), J. Gardner, (AU), Y Nakano (JP), M Pointer (GB), J Schanda, (HU), and R. Sève (FR)

Report:
The latest version of the ILV has still not been published. The Central Bureau is waiting for feedback from some of the Divisions. Divisions 1, 2, and 8 have completed their work and the terms for those Divisions will likely be published shortly. Until a new version of the ILV has been published, it is difficult for TC1-64 to actively pursue its remaining tasks of proposing new terms and reviewing exiting terms.

TC1-65 (C) Visual Appearance Measurement

Year Established: 2003

Terms of Reference:
To study, develop, and recommend a soft-metrology framework for measuring visual appearance. This should include potential measurement areas, psychophysical procedures and real applications.

Chairman: M R Pointer, GB

Members: There are three levels of membership: full, corresponding, and liaison members.

Full members:
P Bodrogi HU, E Burini BR, J Campos ES, A Chalmers NZ, S Cheung KO, P Clarke GB, O da Pos IT, G Derefeldt SE, P Hanselaer BE, R Harold US, J Hutchings GB, , T Kolas NO, S Lindberg SE, D Lozano AR, M R Luo GB, L MacDonald GB, S McFadden CA, T Newman US, J Nobbs GB, C Oleari IT, G Rossi IT, K Sagawa JP, J Schanda HU, D Simmons GB, and F Viénot FR

Corresponding members:
M Brill US, J Veitch CA, C Williamson GB

Report:
This committee has completed a technical report, A Framework for the Measurement of Visual Appearance. This report has also passed a ballot by the Division and the CIE Board of Administration and it will be published in the New Year.

Report Summary
Visual appearance can be one of the most critical parameters affecting customer choice and it needs, therefore, to be quantifiable to ensure uniformity and reproducibility. A starting point in assessing the appearance of a consumer product might be the measurement of its color. A description of its total appearance, however, cannot be achieved by the definition of color alone; other attributes of the material from which it is fabricated contribute to the overall appearance.

Starting from a definition of soft metrology and a description of measurement scales, this report describes a framework on which a set of measurements could be made to provide correlates of visual appearance. It will be shown that the interactions between the various components of the framework are complex, that physical parameters relating to objects are influenced, at the perception stage, by the physiological response of the human visual system and, in addition by the psychological aspects of human learning, pattern, culture and tradition.

The result might be to conclude that an attempt to measure appearance may be too bold a step to take. Thus, a sub-framework is considered in terms of what can now be measured, and what might be measured after further investigation and research. By dealing with the optical properties of materials it is seen that there are, perhaps, four headings under which possible measures might be made: color, gloss, translucency and texture. It is recognized that these measures are not necessarily independent; color may influence gloss, color will certainly influence translucency, and texture is probably a function of all three of the other measures.

Color measurement, colorimetry, is based on the measurement of spectral reflectance, and is an established science that is possible using commercial instrumentation available at reasonable cost. Two shortcomings are identified. First, there are a number of modern materials where color measurements made using a single pair of illumination/viewing angles are not sufficient to describe the perceived colorimetric effect. Thus, measurement at more illumination/viewing 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 colored sample: color appearance models are now able to do this.

The measurement of gloss is an established methodology but there is some doubt as to the scientific basis for making the measurements using the present method and attempts are being made to define alternative approaches. The extension of gloss measurement, which is essentially a measurement made at a specific angle depending on the apparent gloss of the sample, to investigate the shape of the gloss peak, should provide more information.

Translucency is a subjective term that relates to a scale of values going from total opacity to total transparency. This whole subject area needs investigation to find a rigorous measurement solution that will probably be industry specific.

Texture is a harder variable to measure. The advent of digital imaging systems makes the acquisition of images of materials relatively easy, assuming due consideration is given to the resolution of the image capturing device, be it a camera or a scanner. Characterizing these images to give accurate CIE based colorimetry is now possible and the application of suitable analysis software should be able to provide measurement scales that relate to the perceived texture. The idea of establishing a series of 'standard' textures has been suggested.

Expert Symposium. A CIE Expert Symposium on Appearance was held at the Muséum national d'histoire naturelle, Paris, France on 19-20 October 2006. The Symposium was a great success and Françoise Viénot and her team of organizers are to be congratulated on organizing such a splendid event, from both a scientific and a social perspective. There were over 110 delegates, 3 invited papers, 20 presented papers and 23 poster papers. This demonstrates that the 'science' of appearance is an active field and that similar symposium might be appropriate in the future. Proceedings will be published in 2007.

This committee has now fulfilled its Terms of Reference and should be disbanded at the next meeting of Division 1. The future of CIE activity in the field is under discussion amongst committee members.

TC1-66 (C) Indoor Daylight Illuminant

Year Established: 2004

Terms of Reference: To prepare a CIE recommendation on an Indoor Daylight Illuminant and a corresponding Indoor Daylight Source, considering the needs of the partner international standards organizations.

Chairman: J. Schanda, HU

Members: A Bristow SE, C Chain FR, F Clarke (advisor) GB, M K Gunde SI, R Hirschler HU, B Jordan CA, J T C van Kemenade NL, E Pierson FR, K Richter DE, G. Rösler DE, T Tarzali HU, and J Zwinkels CA

Report:
The committee had its meeting during the D1 meetings in Ottawa. Since the meeting several important items on national standards dealing with indoor lighting were received from Dr. Cristiaens, Ms. Tunde Tarczali was able to download the BLI glass transmission spectra, and a report on chromogenic glazings was received from Dr. Klanjsek Gunde.

The Chair is still not ready with summarizing these materials and circulating the next draft of the report to the TC, but this will be done shortly.

TC1-68 (C) Effect of Stimulus Size on Color Appearance

Year Established: 2005

Terms of Reference: To compare the appearance of small (<2°) and large (>20°) uniform stimuli on a neutral background.

Chairman: Peter Bodrogi (HU)

Members: K F Anter SE, I-P Chen TW, O da Pos IT,C S Kim KR, G Kutas HU, M. R. Luo GB, M Nicholson GB, M R Pointer GB, J Schanda HU, R Űnver TR

Advisor: G Derefeldt SE

Report:

The Technical Committee established a website open for members and advisors. Members and advisors of the Committee **answered a survey** with the following questions:

1. *What literature do you know on the Color Size Effect?*

Numerous references were collected.

2. *What is your own experience on the Color Size Effect?*

The color appearance of a large (85° horizontal) homogeneous self-luminous visual stimulus was studied in one of the psychophysical experiments. Large stimuli were displayed on a PDP monitor. The large stimuli were viewed with two values of viewing time: 2 s and 8 s. Large stimuli were compared with 2° standard-size stimuli presented on a grey background on a CRT monitor. The near-immersive color 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 colored pattern varied as a complex function of the size (area) of the colored pattern and of hue. The apparent saturation and lightness of a surface color increased with its size (area). In a study comparing the "inherent" and the perceived color of building facades, viewed in their existing surroundings, a consistent pattern of variation was found. The perceived facade color was always less blackish than the "inherent" color. Whitish colors tended to get increased whiteness, whereas more chromatic colors tended to become even more chromatic. It has also been pointed out that applying the color perception of two-dimensional color stimuli, e.g. computer screen images, can cause 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 colors are subject to changes.

3. *What experiments do you intend to carry out?*

It is intended to carry out a new systematic study on the color appearance of large self-luminous stimuli as well as of NCS color sheets.

4. *What are the relevant real situations and applications?*

Large painted indoor and outdoor areas in architecture, comparing facade colors with small color chips, virtual reality displays with total observer immersion, as well as large screen monitors and televisions. Results of our study should help city planners, landscapers, architects and interior designers predict the appearance of large colored surfaces.

5. *What are the physiological and/or psychological reasons of the Color Size Effect?*

Possibly the spatial distribution of the S, M and L cones but the effect takes place in retinal regions of uniform distribution, too. CIE observers can't describe the stimuli appearing larger than 20° of visual angle. By observing an immersive (very large) homogenous color field, adaptation may be only of secondary importance. Simultaneous contrast was also identified to be one of the reasons of the effect in real-world situations.

6. *How do temporal factors influence the Color Size Effect?*

The instantaneous color impact ("sudden impression") may be important. Observers do not need to adapt to the viewing situation. In a recent study, comparing 2s and 8s viewing of large self-luminous stimuli, duration itself was not a significant factor. This shows that the size effect cannot be attributed to chromatic adaptation to the large stimulus.

7. *How can we quantify the Color Size Effect to find out a usable method for practice?*

For the large (85°) homogeneous self-luminous visual stimulus, a model of the color appearance of large-field stimuli was formulated in terms of the CIELAB L^*, a^*, and b^* values of the standard size stimuli.

The TC did not hold its planned meeting in 2006, but has a meeting scheduled for Beijing in conjunction with the Quadrennial meeting.

TC1-69 (C) Color Rendition by White Light Sources

Year Established: 2006

Terms of Reference:
To investigate new methods for assessing the color rendition properties of white-light sources used for illumination, including solid-state light sources, with the goal of recommending new assessment procedures.

Chairman: W Davis, US

Members: I Ashdown CA, U Binder DE, R Bergman US, P Bodrogi HU, O da Pos IT, R Daubach US, D Ferreira de Oliveira BR, K Hashimoto JP, G Heidel DE, R Hirschler HU, C Kim KR, A Jackson US, W Jordan DE, C Li GB, M R Luo GB, Y Ohno US, M R Pointer GB, E Radkov US, D Rich US, J Schanda HU, B Shugaev RU, F Szabó HU, P van der Burgt NL, H Yaguchi JP, and R Young US.

Report:
Division 1 established this TC at its meeting in Ottawa, Canada in May, 2006. The formation of the committee was approved by the CIE Board of Administration in October, 2006. At the Division 1 meeting, it was suggested that the new technical committee commence with a symposium or workshop at 2007 Quadrennial Meeting. The Board of Administration did select color rendering as a topic for a workshop at the 2007 meeting in Beijing. Following this workshop, we will hold our first TC meeting, which will focus on the development and approval of a working program. We will also compile and disseminate proposals for color rendition assessment procedures and discuss the current state and future directions for visual experiments. The Chair is currently assembling a membership list for the committee.

Color Reporterships

R1-11 (C) Cognitive Aspects of Color: G Derefeldt SE

Year Established: 1994

Terms of Reference:
To survey and present a report on cognitive functions of color in terms of behavioral, neuropsychological and neurophysiological data

Report:
The publication of CIE Publication 166: Cognitive Colour marks the completion of this reportership. Thus was disbanded at the next Division 1 meeting in Ottawa in 2006.

R1-32(C) Emotional Aspects of Color: G Derefeldt SE

Year Established: 2003

Terms of Reference:
To review the literature on various non-image related effects of color and light.

Report:
During this year, I have made a conceptual survey of the terms emotion and feeling from the analysis made by Antonio Damasio, A. (2003) as published in his book *Looking for Spinoza, Joy, Sorrow, and the Feeling Brain*. In his analysis, Damasio follows the tradition of Spinoza, who was one of the first to give attention to the differences between emotions and feelings. Emotions precede feelings in that emotions are more responses to chemical and neural processes than feelings are even if both are closely related and nested and many times difficult to separate. Feelings are interactive perceptions and anchored in our perceptual and somatosensory systems. Feelings are more than emotions dependent on awareness and consciousness. Last year, I made a study of the ideas put forward by Previc, F. H.(1998) in his paper The neuropsychology of 3-D space, *Psychological Bulletin*, Vol.124, pp- 123 –164 to see whether emotions could be related and categorized to his different neuropsychological functions. Previc´s model is not a model of human cognition although it has a neuropsychological foundation. At the CIE meeting in Leon in 2005, I thought it might be a useful model to start the study and classification of emotions related to color. Now, after having read Damasio, I think that Previc´s model still may be useful but it has to be complemented by a more cognitive model. In the Table below, visual functions related to colour are involved in different characteristic functions. For instance, the "emotional aspects of colour" related to visual grasping, manipulation, and consumption of food may be analysed as the "emotional aspects of colour" related to our perception and orientation in the environment? My idea was that the literature to some extent could be categorized according to Previc´s characteristic functions.

Damasio´s analysis indicates that the majority of the traditional literature on the emotional aspects of colour is related to feelings and maybe not be described by Previc´s model.

During the last year, I have collected a lot of papers on color and emotions but I have not yet started the work to classify them. I will start that during 2007.

Table: From Previc, F. H. (1998).

		3-D system		
Characteristic	Peripersonal	Extrapersonal (focal)	Extrapersonal (action)	Extrapersonal (ambient)
Function	Visual grasping, manipulation Consumption	Visual search Object, face recognition	Navigation Scene memory Target orientation	Spatial orientation Postural control Locomotion
3-D locus				
Lateral extent Vertical bias Radial extent	Central 60° Lower field 0-2 m	Central 20-30° Upper field 0.2 m-distance	Full 360° Upper field 2 m-distance	Front 180° Lower field Most distant
Primary coordinate system	Body-centered (upper-torso)	Retinotopic	Gaze-centered	Gravitational/earth-fixed
Sensory systems	**Visual** (global perception; motion, depth) **Somatosensory/ proprioceptive** **Vestibular** Gustatory	**Visual** (local perception; form, color) Proprioceptive	**Visual** (location judgments) **Auditory** Olfactory Vestibular	**Visual** (ambient motion, slant) **Vestibular** **Somatosensory/ proprioceptive**
Motor systems	**Arm movements** **Smooth eye movements** (pursuit, vergence) **Head movements** Upper-torso motion Saccades	**Saccades**	**Head movements** (horizontal) Saccades Upper-torso motion	**Leg movements** Head (neck) movements

R1-33 (C) Color Difference Evaluation: M R Luo, GB

Year Established: 2003

Terms of Reference:
To monitor the response to CIEDE2000, including receiving comments, reviewing relevant literature, and recommending future activity.

Report:
This reportership was closed at the Division 1 meeting in Ottawa in 2006.

R1-39 (C) Alternative Forms of the CIEDE2000 Color-Difference Equation: M. Pointer, GB

Year Established: 2006

Terms of Reference:
To investigate alternative formulations of the CIEDE2000 equation and to make a recommendation to the Division on any necessary action.

Report:
The necessary papers have been obtained and a procedure devised to investigate the problem.

Liaisons

Association International de la Couleur: P J Alessi

The AIC has been very busy with a full meeting schedule from 2006 through 2009. The 2006 meeting was hosted by the Color Group of South Africa at the Misty Hills Country Hotel in Johannesburg, South Africa from October 24-27, 2006. The topic of the meeting was "Color in Culture and Color in Fashion". The proceedings can be downloaded from the AIC website at www.aic-color.org.

The AIC 2007 meeting will be the Midterm Meeting held at Zhejiang University in Hangzhou, China from July 12-14, 2007. This meeting follows the CIE Quadrennial Meeting in Beijing, and it is hoped that CIE participants will travel to Hangzhou to attend this AIC Midterm Meeting on "Color Science for Industry". The main focus of the meeting will be on the application of color technology in manufacturing and product research. The deadline for abstract submission was extended to January 15, 2007. The meeting is hosted by the Color Association of China and the AIC. The coveted AIC Judd Award will be bestowed upon one of our worthy candidates at this meeting. More details of the meeting are available at www.aic07.com.

The AIC 2008 meeting will be an Interim Meeting held in Stockholm, Sweden from June 15-18-2008. The topic of the meeting is "Color - Effects and Affects". The color effects to be discussed are such things as the effect of using color in interior and exterior design when the color impression is changed with distance, light source or other color interactions. The color affects to be discussed come from color psychology, color meaning, color associations and color emotions. This meeting is hosted by the Swedish Colour Centre Foundation and the AIC. More information is available from the meeting website at www.aic2008.org or from the Conference Secretariat at info@aic2008.org.

The AIC 2009 meeting will be the 11th Congress of the AIC. It will be held in Sydney, Australia from September 27 to October 2, 2009 at the University of South Wales. This Congress will cover all aspects color. There will be symposia featuring the AIC Study Groups as well as other topics. Once again the coveted AIC Judd Award will be bestowed

upon one of our worthy candidates at this Congress. More information is available from the Congress website at www.aic2009.org or from web address for communications at aic2009@tourhosts.com.au.

CCPR (Comite Consultatif de Photometrie et Radiometrie), BIPM: M. Stock

The working groups of the CCPR met at the CENAM, Queretaro, Mexico, on 22-24 October 2006. The following gives a short summary of each meeting.

The key comparison working group (WG-KC) initiates key comparisons in the field of radiometry and photometry. These are the technical foundation for the mutual recognition of national measurement standards and of calibration and measurement certificates issued by national metrology institutes in the framework of the CIPM MRA (Mutual Recognition Arrangement, www.bipm.org/en/cipm-mra). A standing agenda item of the meetings is an update on the status of the ongoing key comparisons, carried out by the CCPR and the Regional Metrology Organizations (RMOs). It is a concern of the working group that the organization of key comparisons takes a very long time and ways to streamline this process are searched. At the meeting it was concluded that the key comparisons should be repeated with a periodicity of about 10 years. The next round needs therefore to be prepared soon.

The working group on calibration and measurement capabilities (WG-CMC) coordinates the international review of the declared calibration and measurement capabilities (CMCs) of national metrology institutes. The outcome of this review process is a list of internationally recognized CMCs, which are listed in the key comparison database of the BIPM (kcdb.bipm.org/AppendixC). For radiometry and photometry, calibrations of 37 countries are covered, the total number of recognized calibrations in this field is larger than 900. The working group will develop a table of key comparisons necessary to support these CMCs.

The working group on strategic planning (WG-SP) met for the first time. The working group will advise the CCPR on future directions and will monitor developments with respect to possible future modifications of the SI system of units. The working group concluded that the impact of the proposed redefinition of the kilogram on the realization of the candela would be insignificant. The working group has identified a number of important future measurement challenges for radiometry and photometry, to be included in the report on evolving needs for metrology for the next General Conference of the Metre Convention (CGPM).

The next meeting of the CCPR and its working groups will take place on 18-22 June 2007 at the BIPM. General information on the work of the CCPR can be found on www.bipm.org/en/committees/cc/ccpr.

IALA: M. Nicholson and I. Tutt

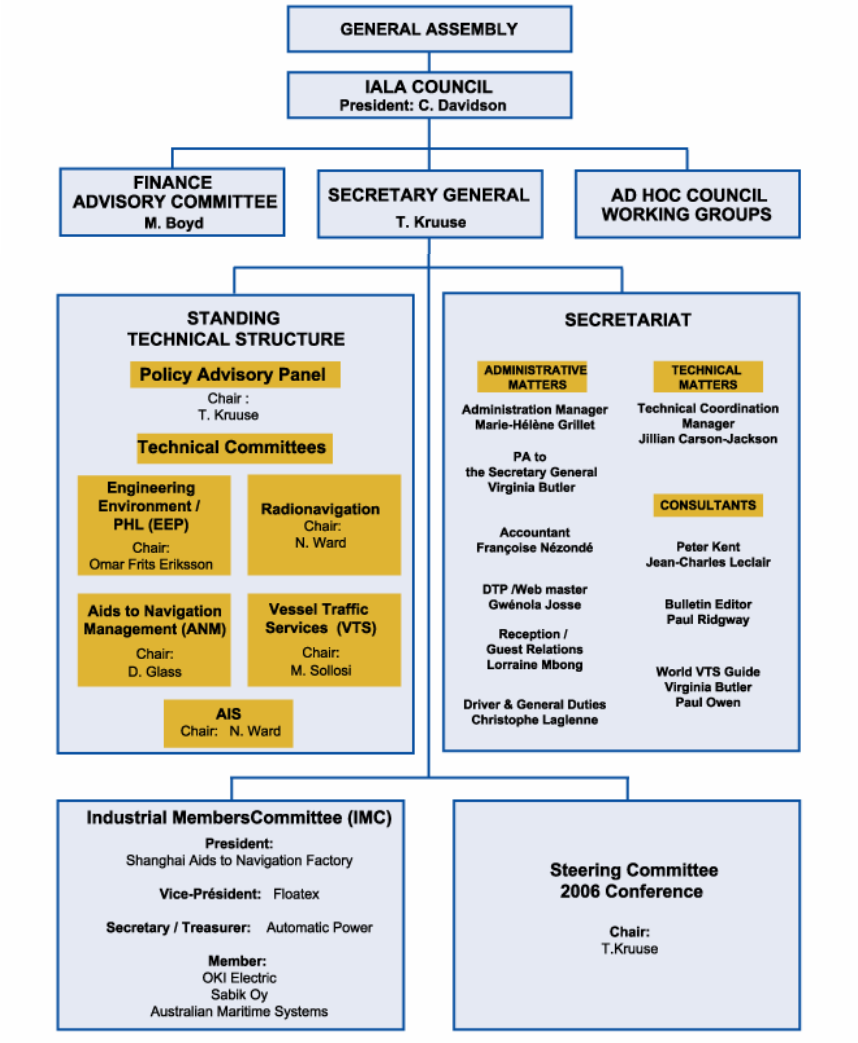
Two committees whose work links closely with that of CIE is the Aid to Navigation Management (ANM) Committee and the Engineering, Environmental, Preservation (EEP) Committee (see structure at end of report). After a very successful conference in Shanghai in May 2006 the work programs for the two committees were approved for the next four years. The items from the work program that may be of interest to CIE are listed below (retaining their program numbers).

ANM: 2) Review existing / develop new documentation on AtoN performance, including calculation and measurement on range of lights to define product quality in cases of

information for outsourcing projects; and 7) Co-ordinate review of the IALA Navguide, including implications of new legal requirements on environmental matters, new technical developments (e.g., synchronized / sequential lights).

EEP: 2) Provide guidance on the use of surface colors for AtoN; 3) Provide guidance on color measurements of lights; 5) Provide guidance on useful / required illumination levels at the observer required for various background lighting conditions; 7) Provide guidance on flash synchronization; 9) Provide guidance to Members on how to assess/calculate probability of detection and recognition of visual AtoN; and 10) Provide guidance to Members on the effective luminous intensity of pulsed lights.

International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) is a non profit making international technical association. Established in 1957, it gathers together marine aids to navigation authorities, manufacturers and consultants from all parts of the world and offers them the opportunity to compare their experiences and achievements. Their structure is shown below.



ISO/TC6/W3: Paper, Board and Pulp - Optical Properties: J C Zwinkels

The most recent meeting of ISO TC6 was in Atlanta, GA (USA), Nov. 12-17, 2006. The WG3 on Optical Properties met on November 13th. The following items are of possible interest to CIE:

1) There is a growing cooperation between WG3 and ISO TC130 on optical measurements for graphic arts. There was a joint meeting of these two committees in Leeds, UK in June 2006 to discuss working together to update and harmonize measurement procedures so that there is closer agreement in practices between the paper industry and the graphic arts industry. At this meeting, the following needs were identified: standards and proper implementation of standards, proper measurement procedure, and visual appearance prediction, i.e. reliably predicting the differences between what is seen and what the instrument measures. With respect to the latter issue of improved optical modeling and simulations, there is a need for angle-resolved measurements including the effect of fluorescence.
2) In the ISO Standard CD 5631-2: D65 Colour, the publication date accuracy at the end of page 2 was questioned and the committee has decided to update the reference to the CIE.
3) In the ISO Standards DIS 2469: Diffuse Reflectance Factor and DIS 22891:1 Diffuse Transmittance, the source of the equations given in Annex B.5 was questioned and this will be changed to have the CIE Source calculations specified in the method.
4) The CIE Liaison to WG3 is Dr. Byron Jordan, who is also the Convenor of this WG. He reported at the meeting on the new developments in CIE; in particular, the work on Indoor Daylight in Division 1 and the survey of the spectrum of indoor illumination in Division 8. With regard to the activities of CIE TC 1-66, it was noted that the preliminary measurements of the transmittance of this glass suggest that the UV content of the new Indoor Daylight Illuminant may be close to that of Illuminant C, and the illuminant has the same correlated colour temperature.

ISO/TC38/SC1: Textiles: Colour Fastness & Measurement: M R Luo GB

The following items have relevance for Division 1:

A method for predicting colour inconstancy based on CMCCON02 was proposed which includes the CAT02 chromatic adaptation transform used in CIECAM02. The final DIS document was completed and is in the process of national ballot voting.

A standard viewing condition for a viewing cabinet was written and is a new work item to be discussed at the next meeting.

A method for assessing colour fastness grades by digital imaging technique was proposed. The method includes an illumination cabinet for capturing images of objects and two formulae for converting colour measurement data to colour fastness grades for colour change and staining respectively. A ring test including labs in 5 countries has just been completed. The data will be used to further verify the methods.

ISO/TC42: Photography: J Holm US

The work of ISO TC42 related to color is primarily carried out in joint working groups with ISO TC130 (Graphic technology) and IEC TC100 (Multimedia systems and equipment). The group responsible for the administration of each standard is listed in parentheses. Information on some projects exclusively in IEC TC100, which may be of interest, is also reported.

The following part of ISO 17321 is now published:

1) ISO 17321-1:2006 Graphic technology and photography -- Colour characterisation of digital still cameras (DSCs) – Part 1: Stimuli, metrology and test procedures (TC42 JWG20). It describes methods for obtaining digital still camera color characterization data. Annex D includes a table of in-situ measured spectral radiances for some commonly occurring objects (foliage, flowers, sky, skin). Some experts have commented that it would be helpful to have a more comprehensive database of in-situ spectral radiance measurements (with the adopted white SPD also recorded).

2) ISO 17321-2 Graphic technology and photography — Colour characterisation of digital still cameras (DSCs) — Part 2: Methods for determining transforms from raw DSC to scene-referred image data (TC42 JWG20) remains withdrawn as an active item of work. Consensus that the method for determining these transforms cannot be standardized, because it depends on the camera spectral sensitivities, the spectral radiances of the colors to be analyzed, and various tradeoffs (e.g. colorimetric accuracy vs. noise amplification). However, research on the use of digital cameras to determine scene colorimetry continues. If at some point in the future there is renewed desire to develop a standard, a NP will be required.

There was some discussion in ISO TC42 and ICC about standardizing the term and definition “camera colour analysis gamut”, but consensus could not be reached to proceed. There still seems to be significant confusion around digital camera color characterization.

The following parts of ISO 22028 are now published as Technical Specifications:

1) ISO/TS 22028-2:2006, Photography and graphic technology — Extended colour encodings for digital image storage, manipulation and interchange — Part 2: Reference output medium metric RGB colour image encoding (ROMM RGB) (TC42 JWG23). ROMM RGB is commonly known in the user community as "ProPhoto RGB", and is output-referred with the same reference medium and viewing conditions as the ICC v4 perceptual intent.

2) ISO/TS 22028-3:2006, Photography and graphic technology — Extended colour encodings for digital image storage, manipulation and interchange — Part 3: Reference input medium metric RGB colour image encoding (RIMM RGB) (TC42 JWG23). RIMM RGB is scene-referred, making it the second scene-referred colour encoding to be standardized (after IEC/ISO 61966-2-2 - scRGB).

Technical Specifications are approved for a period of three years, after which time they can be converted to International Standards, extended for a maximum of another three years, or withdrawn.

ISO 5, Densitometry, parts 1-4 (ISO TC42 JWG21) - Revision has been stalled for two years. The ISO Central Secretariat has indicated that ISO 5-3 is overdue, although it remains available for sale on the ISO web site. Progress is needed soon on this foundational series of standards, which are widely referenced.

ISO 3664:2000, Viewing conditions – Graphic technology and photography (ISO TC42 JWG24) - Work to develop Ed. 3 has begun, with the CD expected soon. The major changes included will be a tightening of the UV tolerances and linking of the display viewing ambient illumination level to the display white point luminance.

ISO 13655:1996, Graphic technology -- Spectral measurement and colorimetric computation for graphic arts images (TC130 JWG8). CD ballot comments will be discussed at the next JWG8 meeting in April, 2007.

ISO 15076-1:2005, Image technology colour management -- Architecture, profile format and data structure -- Part 1: Based on ICC.1:2004-10 (TC130 JWG7) - Several specification additions have been approved in ICC, and ICC v4.3 is in preparation. The differences between ICC v4.3 and ISO 15076-1 may eventually be published as an amendment to ISO 15076-1.

ISO 12231:2005 (Ed. 2) Photography -- Electronic still picture imaging -- Vocabulary (TC42 WG18). A NP draft of Edition 3 is expected soon, to be discussed at the next TC42 WG18 meeting in Lausanne the last week of June, 2007.

IEC TC100 work: IEC 61966-2-1:1999, Multimedia systems and equipment - Colour measurement and management - Part 2-1: Colour management - Default RGB colour space - sRGB (TC100 TA2). A number of comments were received in response to the DC sent out late last year, however, a TA2 ad-hoc group that was formed to recommend a path forward recommended (by a 7-2 vote) to extend the validity date. The validity date was extended to 2012. It has not yet been possible to reach agreement in TA2 to form a maintenance team to address the comments received.

IEC 61966-2-2:2003, Multimedia systems and equipment - Colour measurement and management - Part 2-2: Colour management - Extended RGB colour space - scRGB (TC100 TA2). This standard is currently out for review. Comments are due by 2007-03-02.

IEC 61966-2-4:2005, Multimedia systems and equipment - Colour measurement and management - Part 2-4: Colour management - Extended-gamut YCC colour space for video applications - xvYCC (TC100 TA2) was published in early 2006. Subsequently, some errors were discovered and a technical corrigendum prepared.

IEC 61966-2-5, Multimedia systems and equipment - Colour measurement and management - Part 2-5: Colour management - Optional RGB colour space - opRGB (TC100 TA2). The US commented on the CD ballot that this standard should proceed as a Technical Specification, in view of the fact that it is similar but not identical to the Adobe RGB (1998) color encoding specification. The path forward has not yet been determined, but should be decided shortly.

IEC 61966-4:2000, Multimedia systems and equipment - Colour measurement and management - Part 4: Equipment using liquid crystal display panels (TC100 TA2). This standard is currently out for review. Comments are due by 2007-03-02.

ISO/TC130: Graphic Technology: D C Rich

ISO TC 130 met in San Diego in the spring and in Berlin at the DIN in the fall. Fred Dolezaleck has retired from the committee and Dr. Uwe Bertholdt has been proposed as the new convenor of TC 130 and Mr. Andreas Kraushaar has been proposed as the new convenor of WG3 on Process Control.

Projects of interest to CIE Division 1 include a new task group looking into the contribution of the paper to the color of printing. A recommendation from a report issued by Division 8 requested Division 2 to review the status of the measurement of fluorescent white materials (those containing optical brightening agents) has gone unheeded so TC 130 has

taken it upon itself to initiate a review of the methods of characterization of fluorescent white materials. A first study group was formed and held a meeting during the ICC meetings in June at Leeds University. ISO TC 6/WG3 will join in this effort.

ISO 13655, the standard method for the measurement of the color of printing, is being revised to define the measurement conditions better. They have adopted the ISO notation of Influx : Efflux in lieu of the older CIE illumination / viewing notation. Where appropriate, the new ISO document does reference the latest revision of CIE Publication 15 Colorimetry.

ISO 3664, the standard that describes the viewing conditions for observing the color in graphics arts materials, is also under revision. The purpose of the revision to keep it in close agreement with the revision of 13655. Both standards now define two recommended measurement conditions. Condition M1 requires an "exact" fit to illuminant CIE D50, from 300nm to 780nm. If such a source cannot be obtained then a second measurement condition is being recommended, M2, which eliminates all radiance in the measurement or observing source at all wavelengths shorter than 400nm.

It has been reported at some of the recent meetings that the visual attribute of color appearance known as "whiteness" is not well described by the CIE indices of whiteness. There are some who claim that the visual experience is ill-defined and should be completely scrapped for a newer and more visually based metric. Perhaps Division 1 can take up this challenge and avoid following in the path of Division 2 who has been unable or unwilling to issue a more modern recommendation on the measurement of optically brightened materials like white papers, plastics and textiles. TC 1-44 needs to complete its report on sources of daylight that can be used for visual evaluation of white, fluorescent materials.

ISO/TC159: Ergonomics: K Sagawa

ISO/TC159/WG2 “Ergonomics for people with special requirements” had been working on the development of technical report TR22411 which is a supplementary document containing human data as a function of age and disabilities to follow up ISO/IEC Guide 71 “Guidelines for standard developer to address the needs of older persons and persons with disabilities”. The draft TR22411 is now on voting in TC159. This draft contains data on some age-related visual functions and methods how to use them, a part of which shares the resources collected by CIE TC1-54. Some of the contents of draft TR22411 are being submitted to TC159/SC5/WG5 “Environments for people with special requirements” for international standardization, where assessment of light in terms of age-related related luminance will be discussed.

ISO/IEC JTC1/SC28 Office Equipment: K Richter

JTC1/SC28: “Office equipment” is dealing with some CIE related projects, for example in the field of color copiers, printers and scanners. At present SC28 has four Working Groups: an Advisory Group on Strategic Issues, and Groups on Yield, on Image Quality, and on Productivity see the new SC28 web site http://www.iso.org/jtc1/sc28. The secretariat of ISO/IEC JTC1/SC28 is in Japan (JISC). Additionally there is a new SC28 Standards Interest Group for Colour Comparison (SIG-CC), see the special web site <http://85.25.4.49/sig-cc>

Printer Cartridges Yield Determination. This is the main area of standardization during the last years. There are monochrome (black and white) and color printers of the two types laser

and inkjet. In all cases PDF-test files based on hand coded PostScript programs have been defined to measure the yield. The monochrome and color test charts are freely available at the SC28 web site. The following standards are now published or in preparation:

1) For laser printers and for monochrome printing in documents ISO/IEC 19752:2004 has been published earlier. The PDF-test charts are defined in the standard.
2) For laser printers and for color printing in documents ISO/IEC 19798:2006 has been published. The PDF-test charts are defined in ISO/IEC 24612.
3) For inkjet printers and color printing in documents ISO/IEC 24711:2006 has been published. The PDF-test charts are also defined in ISO/IEC 24612.
4) For inkjet printers and color printing of photos the first working drafts WD 29102 for an intended standard and WD 29103 for the test charts are in preparation.

The agreement on the test charts was very difficult. At the SC28 plenary in 2004 it was decided unanimously to use the cmyk-PS-definition for color, which is the most appropriate definition for printers with CMYK colors. At the following SC28 plenary in 2005 and after much discussion the majority of the countries agreed to use the rgb-PS-definition for color. This is an advantage for rgb workflows. The disadvantage is that the so called One-Minus PostScript-relation to calculate the cmyk values from rgb values is not used any more in many rgb workflows for the output and then the yield determined by the standards may vary a lot. Additionally the device dependent rgb primaries of the CRT monitors are very different compared to the secondary colors (rgb) of cmy printing and there is no agreed method for this transformation. A new idea is to use instead of device dependent rgb values the device independent rgb values of the kind elementary (unique hue) colors which are represented by the CIE-test colors no. 9 to 12 of CIE 13.3. Test charts for output based on elementary hues with questionnaires are at the URL http://www.ps.bam.de/RLAB00E

Some workflows which use rgb values analyze any printed page before printing. If there is only one color pixel on the page then the black text may be printed by overprint of cyan, magenta and yellow. This may increase the cost per page by a factor 9 compared to printing with the black ink. It is expected that the yield determination will reduce these and similar kinds of printing methods.

For the output the possibility of using a standard color management method, for example ISO 15076-1:2005 which is based on ICC-color management, was discussed. This possibility was not accepted by any country because there seem to be too many free variables, for example free output of tone functions, free gamut mapping (compare the many gamut mapping methods in CIE 156:2004:), and free re-rendering etc. which all produce a large variety of outputs. Additionally there is a larger measurement problem of the printed colours on the fluorescent paper used in offices (compare the effects of fluorescence in the characterization of imaging media, CIE 163:2004).

SC28 standard documents including editor and title of 2005 and 2006.

1) ISO/IEC TR 24705:2005, Editor Klaus Richter (DE), Method of specifying image reproduction of colour devices by digital and analog test charts
2) ISO/IEC 19798:2006, Editor Paul Jeran (USA), Method for the Determination of Toner Cartridge Yield for Colour Printers and Multi-function Devices that contain Printer Components
3) ISO/IEC 24711:2006, Editor Paul Jeran (USA), Method for the Determination of Ink Cartridge Yield for Colour Ink Jet Printers and Multi-function Devices that contain Printer Components I

4) SO/IEC 24712:2006, Editor Paul Jeran (USA), Color Test Pages for Measurement of Office Equipment Consumable Yield
5) ISO/IEC 19799:2006, Editor Yee Ng (USA)), Method of Measuring Gloss Uniformity for Printed Pages

Other standard documents including editor and title under work: 1) ISO/IEC 24734, Editor Yee Ng (USA), Method for Measuring Digital Printer Productivity; Status: WD; 2) ISO/IEC SC28 N 935 ISO/IEC 24735, Editor Yee Ng (USA), Method for Measuring Digital Copying Machine Productivity; Status: WD; 3) ISO/IEC SC28 N 938 ISO/IEC 24790 (Revision of ISO/IEC 13660), Editor Toshihiko Inagaki (JP), Measurement of image quality attributes for hardcopy output –Binary monochrome text and graphic images; Status: NWI approved in July 2006; 4) ISO/IEC 28360 (ECMA-328, 2nd edition), Determination of Chemical Emission Rates from Electronic Equipment, Status: Fast Track Procedure until October 2006. Also, in 2006 a new work item from Korea was an accepted: Test Chart and Method for Measuring Printer Resolutions of Monochrome Laser Printers

Future of SC28 and meetings. In the 2005 CIE D1 activity report, it was mentioned that five new work item proposals, which had been supported by the SC28-Advisory Group, failed that year. This may be one reason that the document "Japan Proposals for the structural reform of SC28" is now under discussion. Especially the cooperation between SC28 and other standard groups could be improved, and also a long term strategy for color coding, accessibility and management for scanning and printing is missing. The next SC28 plenary meeting will be in May 2007 in Japan. At its last meeting in Nov./Dec. 2006 in Geneva, ISO/SCIT (Steering Committee on Image Technology, see http://www.iso.org/scit/), which has SC28, the CIE, and other standard groups as members, resolved to organize a meeting on Image Technology in Europe. The meeting location, probably London or Berlin, will be decided before March 2007.

Recent Publications

CIE 170-1:2006 Fundamental chromaticity diagram with physiological axes - Part 1
CIE 175:2006 A framework for the measurement of visual appearance
CIE 177:2007 Colour rendering of white LED light sources
CIE x030:2006 - Proceedings of the ISCC/CIE Expert Symposium '06 - 75 Years of the CIE Standard Colorimetric Observer
CIE Draft Standard DS 014-4.2/E:2006 Colorimetry - Part 4: CIE 1976 L*a*b* Colour Space

CIE Book on Colorimetry

The content of the book, the preprint volume of which was made available to the participants at the D1 Ottawa meeting, has been peer reviewed by CIE D1 experts, and the editor is thankful for the many important comments he received and to the authors who considered them and sent their updated version of the chapters. The manuscripts are now at Wiley, the publisher of the book. At this point, the publication date is not available.