



Annual Report  
of the  
National Illumination Committee of Great Britain

*Provisional pending accounts*

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1<sup>st</sup> October 2015 to 30<sup>th</sup> September 2016

## Report for the year ending 30 September 2016

After the excitement of hosting the 28<sup>th</sup> CIE Quadrennial Session in July 2015, this year has (thankfully!) been much quieter. I think everyone involved in the organisation of CIE 2015 can look back with pride on an event that was the very embodiment of the CIE: lively and well-informed discussions, presentations and exchange of knowledge and expertise in all the many and varied fields representing “the science and art of light and lighting, colour and vision, photobiology and image technology”. On a personal note, I feel very honoured to have taken over the Chairmanship at the end of last year from Nigel Pollard, whose vision, drive and determination was absolutely key to success of the meeting.

CIE-UK’s finances received a welcome boost from hosting the Quadrennial Session and this puts us on a reasonably sound footing for the future. Support has been provided to a number of members during the year, to assist with travel to meetings, and this will continue into the future.

The CIE-UK Trustees are always looking to increase the awareness and impact of CIE’s work in the UK, and with this in mind we plan to carry out a complete overhaul of the CIE-UK website. If any members have suggestions relating to information that they would like to see on the website, do please let me know.

The CIE Board of Administration has a similar desire to maximise the impacts of the technical work carried out within the Divisions and Technical Committees, and to focus the work of technical experts from around the World in those areas where it will have greatest benefit. To this end a CIE Research Strategy has just been launched, which details ten top priority topics requiring research and development. It is hoped this will be used by industry, academia and research institutes to inspire and support their research plans; if CIE is to be able to develop consensus-based technical reports and standards to meet emerging needs in these key areas, it is essential that scientists engage now in building the knowledge base that will support them. The CIE Research Strategy is available on the CIE website ([www.cie.co.at](http://www.cie.co.at)) and I encourage you all to read it.

Finally, I would like to thank you all for your support for CIE-UK, and CIE more generally, during the past year.



Teresa Goodman  
Chair of CIE-UK

## Division 1: Vision and Colour

### Terms of Reference:

*To study visual responses to light and to establish standards of response functions, models and procedures of specification relevant to photometry, colorimetry, colour rendering, visual performance and visual assessment of light and lighting.*

During the last year Division 1 met in Prague, Czech Republic. This was part of the 4th CIE Expert Symposium on Colour and Visual Appearance. This was the first meeting under Division Director Youngshin Kwak (KR). 19 countries were represented.

### 1. Division Research Strategy

- Colour Quality of Light Sources Related to Perception and Preference
- Application of New CIE 2006 Colorimetry
- Visual Appearance: Perception, Measurement and Metrics
- A comprehensive colour appearance model based on CIECAM02
- Visual Impairment

### 2. Publications in the last year

CIE 170-2:2015 11 Fundamental Chromaticity Diagram with Physiological Axes – Part 2: Spectral Luminous Efficiency Functions and Chromaticity Diagrams (November 30, 2015)

CIE 217:2016 Recommended Method for Evaluating the Performance of Colour-Difference Formulae (February 17, 2016)

CIE TN 006:2016 Visual Aspects of Time-Modulated Lighting Systems – Definitions and Measurement Models (August 31, 2016) Recent Publications: Standards

### 3. Technical Committees, Joint Technical Committees and Reporters

Having published their reports TC 1.36 and TC 1.55 were closed by the CB during the past year. There are currently 16 Technical Committees (6 Vision + 10 Colour), 4 Joint Technical Committee, 10 Reporters and 10 Liaisons to Division 1. Of these 3 Technical Committees TC1-95 – TC1-97, and 4 Reporters, R1-66 – R1-70 were added at Manchester 2015.

#### 3.1 Colour

TC1.63 Validity of the Range of CIEDE2000: Klaus Richter DE

- Visual experiments were carried to investigate how different colour-difference formulae performed for large and extra-large colour differences.
- For large and extra-large colour differences a power function modification improves the performance for the five colour difference formulae CIELAB (1), CMC (2), CIE94 (3), CIEDE2000 (4), and LABJND (5), in particular for the LABJND formula. The constants in the modification are optimized for experimental data from Small Colour Differences (SCD) with  $0 \leq \Delta E^*_{ab} < 5$ . If large and extra-large colour differences in the range  $5 \leq \Delta E^*_{ab} < 199$  are included then in addition in this range the performance of the STRESS values improves.
- Preliminary Recommendations of TC1-63 (Aug. 2016) include the following:

The power function (PF) correction improves the performance of both the CIELAB and the CIEDE2000 formulae, the performance of CIEDE2000\_PF is better than CIELAB\_PF because it yields less variation in STRESS values for LCD colours, and has nearly constant STRESS values, for the extra-large colour differences (ELCD). 2. The CIEDE2000\_PF formula performs best for small colour

differences (SCD)  $0 < \Delta E^*_{ab} < 5$ . This is the main application area for industrial colour tolerances. Therefore, if only one formula shall be applied for the whole colour difference range  $0 < \Delta E^*_{ab} < 199$ , the TC1-63 report recommends the use of the formula CIEDE2000\_PF.

- According to the terms of reference of TC1-63 the validity of CIEDE2000 shall be studied. For the colour differences in the LCD and ELCD range, the formula CIELAB\_PF performs similar or slightly better than CIEDE2000\_PF. The main application area for these colour differences is colour reproduction for example output on displays, printers, and in offset printing.
- More research is needed about the LABJND formula. This formula was developed for Just Noticeable colour Differences (JND). The use of the PF modification LABJND\_PF may be studied further.
- Version 12 of the report with many high quality drawings (eps format) is expected in November 2016.

TC1.76 Unique Hue Data: Sophie Wuerger DE

- The TC 1-76 report is almost finished. Some data needs to be put in the right format.

TC1.81 Validity of Formulae for Predicting Small Colour Differences: Klaus Richter DE

- The Technical Report of TC1-81 was approved by all TC members in November 2015, with resolution of the comments in Jan. 2016. The TCC distributed a first draft of the CIE CB Which received many comments. An improved draft was produced during June 2016. The draft TC1-81 report has passed the committee vote and the Division editor.
- Version 2 of the TC1-81 report will include many vectorized drawings. The drawing in the report are in EPS format. Publication is expected in May 2017.

TC1-85 Update CIE Publication 15:2004 Colorimetry: Ellen Carter US

- E Carter approved as replacement Chair.
- Draft 11 was reviewed and converted into the CIE CB recommended format as Draft 12.
- Data added for CFL lamp.
- TC and DD discussions about typical LED illuminant proposal from Div. 2 during the Melbourne Meeting.
- New 1 nm Tables for Typical Fluorescent illuminants that suited mercury lines better than the earlier tables.
- Tables for Typical LED illuminants produced.
- The TC met in Prague and discussed 1) Are the CRIs Correct in Tables 12 and 13? 2) What to do with Comment Boxes & the material in them, 3) Recommendations from R 1.63 Tristimulus Integration, 4) Note 3 in 9.5 Calculation of CCT, 5) Adding CFL spectra.
- It is the goal to submit Draft 13 to the BA in time to be published no later than Spring 2017.

TC1.86 Models of colour emotion and harmony: Li-Chen Ou, TW

- Graphs of data from six studies (Chinese, Taiwanese, Spanish, Iranian, Argentinian and Hungarian) showing the effect of hue difference, chroma difference, lightness difference, and lightness sum on colour harmony were shown, using a simplified universal model of colour harmony.
- Comparison of the new model and Ou-Luo model (2006) in terms of correlation coefficient based on CIELAB, show an improvement in correlation coefficient from 0.63 to 0.72.

- The next steps include: Writing up a paper based on the results, and writing a working draft of the technical report.

#### TC1-90 Colour Fidelity Index: Hirohisa Yaguchi JP

- After the TC meeting in the end of March in Melbourne, the 4th draft was delivered for a ballot by TC members.
- The results of a ballot were 18 in favour, 6 against (5 from Japanese TC members), and 8 abstained.
- The technical report will not be published without agreement from all authors. An agreement was reached, but necessitated a change in the terms of reference for the TC to: "To evaluate available indices based on colour fidelity for assessing the colour quality of white- light sources with a goal of recommending a ~~single~~ colour fidelity index ~~for industrial use~~" This was agreed by the Division Meeting, as was extension of activity of TC1-90 for another 4-year term.
- The next step is to complete the final version of WD for voting by the end of September.

#### TC1-91 New Methods for Evaluating the Colour Quality of White-Light Sources: Yandan Lin CN

- Criteria for Inclusion of the Colour Metrics in TC1-91 Technical Report agreed.
- Draft report V4.0: includes indexes of CQS, FCI, MCRI, PS and IES Rg, Relative gamut area index (Ga), Colour rendering vectors and colour saturation icon.
- Response: One replied with comments.
- Draft report V4.1: Two more experiments (part 4.7) added. Some other contents need to be completed. New draft WD5 circulated to TC members for comments.
- A change in title of the technical report of TC1-91 "~~New~~ Methods for Evaluating the Colour Quality of

White-Light Sources" was agreed by the Division Meeting.

- Extension of activity of TC1-91 for another 4-year term was agreed by the Division

#### TC1.92 Skin colour database: Kaida Xiao GB

- Measurement uncertainty: Repeatability - Skin colour variation between same skin measured by same instrument and setting in different repetition. Spectrophotometer (measurement pressure, measurement size); TSR (measurement distance); Camera (measurement distance).
- Skin colour variation between same skin measured using different instrument and settings.
- Spectrophotometer vs. TSR vs. camera prediction vs. visual assessment.
- The existing skin colour database (2013-2015) included Caucasians (UK), Chinese, Thai and Kurdish. The new skin colour database (2016) added Asian (Pakistani) and Caucasians (Spain) focusing on spectral difference.
- Skin variations were reported in colorimetric and spectral differences. The skin colour variation, colour gamut, appearance shift between different ethnic group, gender and body areas. The spectral differences were analyzed between different ethnic groups, gender and body area, and the same subject before and after suntan, and before and after exercise.
- Several publications were made by TC members.

#### TC1.95 The Validity of the CIE Whiteness and Tint Equations: Robert Hirschler HU

- This newly formed TC has the terms of reference based on published and new experimental work.

- The TC shall seek to recommend modifications to the existing CIE Whiteness and Tint Equations to extend their application to illuminants other than D65. Furthermore, the TC shall review the restrictions imposed on the validity of the equations to samples that are measured on the same instrument at nearly the same time, and review the colorimetric limits hitherto set. If enough experimental data justify it, the TC may recommend modifications to the current CIE Equations for Whiteness and Tint.
- The TC held its first meeting in Prague on 8th September 2016 with 7 members and 6 guests attending. After an introduction by the chair, presentations were given by Ronnier Luo, Michal Vik & Dragan Sekulovski. This was followed by discussion on samples to be presented, light sources and visual evaluation methods.

#### TC1.96 A Comprehensive Model of Colour Vision: Ronnier Luo GB

The TC was established April 2016 and has the following work plan

- Year 1: (July 2015-6) To test the existing comprehensive colour appearance models by accumulating experimental data for analysis using those models.
- Year 2: (July 2016-7) To integrate the best features from the existing models to form a new comprehensive appearance model and further test it using the available data.
- Year 3: (July 2017-8) To write a CIE Technical Report presenting a recommendation of reference including CAM02-UCS as a UCS. However, it does not have a reverse model.
- Two journal papers on models were published, but both models have limitations.
- In Prague, the progress of the TC was reported and a number of leading researchers reported the recent progress on data collection, and model testing.
- It is hoped that a model will be finalized at CIE2017 meeting in Jeju, Korea.

#### JTC8 (D1/D2/D3/D4/D5/D6/D8): Terminology in Light and Lighting

Year Established: 2015

Terms of Reference: To address any issues regarding terms and definitions related to the International Lighting Vocabulary (ILV). This includes coordination within CIE Divisions to maintain and update the ILV, coordination with IEC on questions related to the incorporation of ILV terms and definitions into IEC 60050-845 "International Electrotechnical Vocabulary. Lighting", coordination with ISO/TC 12 on questions related to the incorporation of ILV terms and definitions into ISO 80000-7 "Quantities and units – Part 7: Light and radiation" and any further terminology issues within CIE.

- Over the past few months, the primary task of JTC8 has been to review all of the definitions in the current version of the ILV, CIE S017 2011, with the goal of making the definitions compliant with "ISO/IEC Directives, Part 2: Principles and rules for the structure and drafting of ISO and IEC documents". The chair reviewed all of the terms and proposed changes to make the terms compliant with the directive. The Division representatives then reviewed all of the terms associated with their Division. In most cases the proposed changes were largely editorial. The major problems arose with terms with two definitions. According to the ISO directive, a term can only have one definition. Within Division 1, all issues have been resolved to the satisfaction of the D1 members of JTC8.
- The main remaining issue is the numbering of the terms. CIE S017 2011 used a different numbering system from previous versions. The terms were ordered alphabetically and each term was assigned a number based on its location in the alphabetical list. The problem with this schema is that every time a new term is added the numbers for all terms further down in the alphabetic list change. It is undesirable for the number associated with a term to change periodically. An alternate numbering schema will be discussed at the next meeting of JTC8. Once

that decision has been made, the ILV will be sent to all National Committees and the Board for comment and ballot.

- As well as reviewing the ILV, JTC8 reviewed and approved the draft Technical Memorandum prepared by TC1-64. It was agreed that, rather than publishing the TN, the terms and definitions in it will be included in the updated version of the ILV to be distributed for comment and ballot later this fall.
- IEC is currently reviewing and updating IEC 600050. CIE holds primary responsibility for section 845 of that document. IEC has asked CIE to review that section and recommend changes. An initial review was completed in January. A review of the revised version of three of the sub-sections was carried out in August. However, most of the terms in those sections do not apply to Division 1.

#### R1.42 Extensions of CIECAM02: Changjun Li CN

- TC 8-11 on CIECAM02 – Mathematics had a TC meeting in Manchester in 2015. In the meeting, the progress of the TC8-11 was presented by the chair. However, the TC was established for 8 years already and did not fulfil its aim within the two-term period. The TC was given 3 months to find a new chair. However, no one wanted to take over and as a result TC8-11 was closed officially after the CIE Manchester meeting.
- Some progress has been made by the former chair and some of the members since then. Some research results were presented in Electronic Imaging 2016 in San Francisco and ACA2016 in Changshu, China.
- Part of the progress will be presented at CIC 2016. A journal paper is in preparation. It is hoped that the results in this paper will form a new CAM for replacing CIECAM02. Therefore, it might be the time to consider closing this reportership and establishing a new TC (i.e. a joint TC between D1 and D8 might be better) for updating the CIECAM02.

#### R1.53 Gloss perception and measurement: Frédéric Leloup BE

- A review article was written and published.
- Some papers on measurement methods have been produced.

#### R1.58 Liaison with ISO TC130 Graphic Technology: Phil Green GB

There has been no recent progress on R1-58.

#### R1.60 Future colour difference-evaluation: Guihua Cui CN

There were about 77 papers/books/chapters published/presented on colour difference or colour spaces, in English, in 2015-2016.

#### R1.61 Source Whiteness Metric: Aureian David US

There has been no recent progress on R1-61.

#### R1.62 Typical LED Spectra: Sophie Jost FR

With the following Terms of Reference: 1) To collect available LED spectra, 2) Analyze the difference among the spectra with the aim of finding possible typical spectra for various classes e.g, cool white, and warm white. The Spectra Collection includes 850 SPDs.

- Spectra were tabulated at 5-nm intervals from 380 nm to 780 nm and normalised to 1 unit for the maximum peak intensity. Repeated spectra were deleted and the data were organised similarly to the Kevin Houser database. For each SPD within the database there was the source of the SPD, a source number, a description, a 3 letters code, chromaticity coordinates, Duv, CCT, and Ra as well as the spectral data.

- Clustering involved separating the different technologies of InGan blue (around 450nm) + phosphor (BLED); InGan blue (around 450nm) + phosphor +red InGaAlP (BLED+RED), and InGan violet or purple (around 400nm) + RGB phosphor (VLED). The Agglomerative Hierarchical Clustering (Pearson correlation coefficient, Complete linkage) method was used.
- The results following the criteria of: 1) Between 3 to 8 typical spectra, 2) Average spectrum, and 3) Representing CW and WW, were five SPDs broken into the following groups: 1) BLED, with 1a) BLED\_WW and 1b) BLED\_CW; 2) BLED+RED, and 3) VLED.
- The future work of this reportship is to work with three groups: 1) TC 1.85 on Updating CIE 15 on Colorimetry, 2) EMPIR project PhotoLED, and 3) Division 1 & 2.

#### R 1.63 Tristimulus Integration: Changjun Li CN

- TC 1-71 on Tristimulus Integration was closed in 2015 during the CIE Manchester meeting. This reportship was established during the meeting. Two references [1,2] in this area are useful.
  - [1] Z. Wang, B. Zhao, J. Li, M. R. Luo, M. R. Pointer, M. Melgosa, C.J. Li\*, Interpolation, Extrapolation and Truncation in Computations of CIE Tristimulus Values, Color Res Appl, 2015 doi: 10.1002/col.22016
  - [2] C.J. Li, M. R. Luo, M. Melgosa, M. R. Pointer, Testing the Accuracy of Methods for the Computation of CIE Tristimulus Values Using Weighting Tables, Color Res Appl, 2016, 41:125-142
- Reference [1] has the following findings: 1) Third order spline is the best for interpolation for uniform sampling, which does not support the CIE recommendation [CIE 167:2005] using the Sprague interpolation method. 2) Second order Extrapolation is the best, which does not support the CIE recommendation [CIE 167:2005] using the Sprague interpolation method. 3) The visible wavelength range from 360 nm to 780 nm is better than the range from 380 nm to 780 nm. The former range is used by ASTM and the latter is used by CIE. The above results might be useful to the TC1-85 for the revision of the CIE 15 Colorimetry.
- Reference [2] findings: that for computing TSVs for the object colours, the best method among all available methods including the CIE and ASTM recommendations is the least square (or named as LWL according to the names of authors) method for any uniform sampling intervals. Again, the above result might be useful to the TC1-85 on the revision of the CIE 15 Colorimetry.

#### R 1.64 Real Colour Gamuts: Changjun Li CN

TC 1-73 on Surface Colour Gamut was closed in 2015 during the CIE Manchester meeting. This reporter ship was established during the CIE meeting.

No further work is reported at this stage.

#### R 1.65 Categorical Colour Identification: Taiichro Ichida JP

No further work is reported at this stage.

### 3.2 Vision

#### TC1-83 Visual Aspects of Time-modulated Lighting Systems: Dragan Sekulovski NL

A TC meeting was held in Prague, where the following were discussed:

- CIE TN 006:2016 Visual Aspects of Time-Modulated Lighting Systems – Definitions and Measurement Models published in Sep.2016.
- Multiple phantom array experiment in Korea.
- Two phantom array experiment in China.
- Further work on the flicker method in the time domain in Eindhoven.

#### TC1-84 Definition of Visual Field for Conspicuity: Nana Itoh JP

A TC meeting was held in Prague, where the following were discussed:

- Review the Chapters 1.3 and 2
- Comments or questions for whole WD-2016. All attendees generally agreed WD. (Including some term changes.)
- Final comments will be collected by the end of Dec. 2016.

#### TC1-88 Scene Brightness Estimation: Yoshiki Nakamura JP

A TC meeting was held in Prague, where the following were discussed:

- Experiments and results on scene brightness carried out by members were explained and discussed.
- The outline of a Technical Report was discussed and generally agreed upon.
- Some members were assigned to write various parts of the report.

#### TC1-89 Enhancement of Images for Colour Defective Observers: Po-Chieh Hung JP

A TC meeting (13th) was held on 19 December 2015 using WebEx.

- Collecting manuscripts is ongoing.
- Reviewing and editing the manuscripts to align with the CIE CB Technical Report format.
- About 1 year behind the original schedule. An extension of activity of TC1-89 for another 4-year term was agreed by the Division.

#### TC1-93 Calculation of Self-luminous Neutral Scale: Robert Carter US

A TC meeting was held in Prague, where the following were discussed:

- The TC has three objectives: 1) recommend a grey-scale formula, 2) specify the meaning of neutral and 3) show that the formula is useful in calculation of self-luminous colour difference.
- The TC is recommending Paul Whittle's formula for Equal Perceptible Differences (EPD), published in Vision Research in 1992, and endorsed in a 2011 review in Vision Research by FAA Kingdom.
- The formula has been used by TC members to calculate suprathreshold EPD (e.g., 128 steps of lightness for an electronic display), to estimate threshold JNDs (the DICOM GSDF), to match greys having different background luminances, or to quantify the similarity of targets and distractors in a visual search.
- The draft TC report includes new data showing that the Whittle formula is at least as good (slightly lower stress) as the DICOM GSDF for expressing self-luminous grey scale, while also being more versatile.
- The draft TC report includes an analysis by Dennis Cousin showing that, compared to a standard formula used in the digital video industry (and compared with reference data on visual discriminations), Whittle's formula performs well in the photopic range of luminance, but that it performs less well in mesopic and scotopic realms. The TC Chairman offered Professor Hiro Yaguchi's luminous efficiency models as a way to extend the Whittle formula into subphotopic luminances.
- The TC has reviewed literature, and drawn on Kevin Smet's (a TC member) research, to define self-luminous neutral as the chromaticity coordinates of Bosten, Beer and MacLeod 2015 Journal of Vision, near D65. Based upon a preponderance of evidence, this neutral (i.e., colourless)

chromaticity locus is presumed to generalize across photopic luminances. The chromatic adaptation model from Mark Fairchild's text complete's the TC's specification of self-luminous neutral.

- The draft TC1-93 report shows the usefulness of Whittle's formula in colour difference calculations with CIELAB, CIELUV and the OSA-UCS. Research with CIEDE2000 is in progress.
- A committee vote on the draft TC1-93 report is imminent.

TC1-97 Age- and Field-Size-Parameterised Calculation of Cone-Fundamental-Based Spectral Tristimulus Values: Jan Henrik Wold NO

A TC meeting was held in Prague, discussing the work plans:

- Development of concept/procedure and program code for age- and field-size parameterised calculation of cone fundamental-based relative spectral luminous efficiency functions.
- Development of concept/procedure and program code for age- and field-size parameterised calculation of cone fundamental-based spectral tristimulus values and corresponding chromaticity diagrams, compliant with the principles of the CIE XYZ concept.
- Development of concept/procedure and program code for age- and field-size parameterised calculation of cone fundamental-based XYZ tristimulus values of purple-line stimuli as a function of complementary wavelength.
- Investigations and decisions on the choice of upper and lower limits for the age parameter in the calculations.
- Design and coding of GUI for the standalone program (Python)
- Design and coding of GUI for the web application (online calculation).
- Coding of MATLAB plug-in (MATLAB).
- Facilitation of "User guides" for the stand-alone program, the web application and the MATLAB plug-in.

R1-66 The Effect of Dynamic and Stereo Visual Images on Human Health: Hiroyasu Ujike JP

A change for the R1-66 reporter to produce a Technical Note instead of a reporter's report was agreed by the Division.

JTC-1 Implementation of CIE 191: Mesopic Photometry in Outdoor Lighting: Stuart Mucklejohn GB

Terms of Reference:

WG 1 (Tatsukiyo Uchida JP Chair): To investigate adaptation and viewing conditions and define visual adaptation fields in outdoor lighting.

WG 2 (Stuart Mucklejohn GB Chair): To define lighting applications where mesopic photometry could be used; To provide guidelines for implementing mesopic photometry in outdoor lighting.

- Last TC meeting was held in Melbourne, March 2016.
- Technical Report from WG1: A Second Draft, which was 70% of complete was circulated in Feb. 2016. WG1 is waiting for the remaining contributions from members.
- Technical Note from WG2: TN Draft was prepared by WG members, as an interim report of JTC-1. It was circulated in July 2016. Some editorial comments were received and already addressed. Now it is moving on to TC ballot.

JTC-7 Discomfort Caused by Glare from Luminaires with a Non-Uniform Source Illuminance: Co-chair: Naoya Hara JP (D3)

Terms of Reference:

- To review the literature on glare from non-uniform light sources to identify the parameters that influence the discomfort prediction (UGR) and define limits to the applicability of the UGR formula.
- To propose a correction to the UGR formula that takes into account the non-uniformity of glare sources.
- Yukio Akashi JP was agreed by the Division to act as the co-chair of JTC-7 from D1.

JTC-9 Quantifying ocular radiation input for non-visual photoreceptor stimulation.

Terms of Reference:

- To define action spectra and metrics in order to quantify the ocular radiation input to all photoreceptors possibly involved in non-visual responses.
- To provide a method to calculate from a measured spectral irradiance, ideally at the cornea surface, the stimulation of each photoreceptor that can potentially contribute to non-visual responses.
- To demonstrate the validity of such metrics for predicting physiological responses based on existing data in the literature.
- Nana Itoh JP was agreed by the Division to act as the chair of JTC-9 for D1.

#### [4. New Technical Committees, Joint Technical Committees and Reporters](#)

One new reporter was approved in Prague.

Reporter Title: Revisiting Correlated Colour Temperature

Reporter: Youngshin Kwak KR

Terms of Reference: To review the literature related to perception of colour of white light sources with a goal to investigate the concept of correlated colour temperature.

#### [5. Liaisons](#)

Reports were received in Prague for 6 of the 9 liaisons for Division 1.

- L1-02 CCPR (Consultative Committee for Photometry and Radiometry)
- L1-03 ISO/TC6/WG3 Paper, Board and Pulp – Optical Properties
- L1-05 ISO/TC42 Photography
- L1-06 ISO/TC130 Graphic Technology
- L1-07 ISO/IEC/JTC1/SC28 Office Equipment
- L1-09 ISO/TC159/WG2 Ergonomics

#### [6. Next D1 meetings](#)

2017: As part of the 2017 CIE Mid-term Meeting 20-27 October 2017, Jeju, Korea.

2018: As part of the 2018 CIE Symposium April 2018, Taipei, Taiwan

Dr Peter Clarke

p.clarke@tintometer.com

November 2016

## Division 2: Measurement of Light and Optical Radiation

### Terms of Reference

Most of the work in CIE Division 2 relates to the provision of guidance on the correct measurement of the optical radiation (ultraviolet, visible and infrared radiation) emitted by lamps, luminaires and other sources and on the correct characterisation of detectors and materials. Such measurements are essential to ensure the safe and effective working of a very wide range of products with which the public come into regular contact, including: traffic lights, car headlamps, airport runway lights and railway signals; high visibility clothing; ultraviolet lamps used, for example, in medical treatment of skin conditions and for the curing of dental epoxies and other adhesives; barcode readers in supermarkets; lighting in homes, offices, schools, shops and so on; and visual displays used not only for entertainment applications (television, computer gaming, cinema etc.) but also 'serious' applications such as medical diagnosis and surgical training. Optical radiation measurements are also essential for monitoring the impact of human activity on the environment e.g. ozone depletion, changes in land use, deforestation and global warming.

### Division Officers

- Division Director Peter Blattner
- Associate Directors Hiroshi Shitomi, Armin Sperling, Joanne Zwinkels
- Division Secretary Tony Bergen
- Division Editor Jim Gardner

### Activities and Achievements

Activities and achievements of the Division during the year October 2015 – September 2016 were as follows:

- One new CIE Technical Report has been published by Division 2:
  - CIE 210:2016 Characterization and calibration methods of UV radiometers
- Two CIE Technical Notes have been published by Division 2 during this period:
  - TN 004:2016 The use of terms and units in photometry – Implementation of the CIE system for mesopic photometry
  - TN 005:2016 Specifying product performance for mesopic applications
- Division 2 organised a CIE Tutorial and Expert Symposium on the CIE S025 LED Lamps, LED Luminaires and LED Modules Test Standard, which was held at PTB Braunschweig, Germany in November 2015. This was very well-attended and generated a great deal of positive feedback. A follow-on event will be held next year in Switzerland.
- The Division organised a workshop on the definition of radiance and luminance as part of the CIE 2016 conference on lighting quality and energy efficiency. This has been a hot topic of debate in the Division for more than a decade but has now reached a critical level of importance due to related work on definitions in ISO. The workshop discussed the latest proposals that have been put forward and the general opinion was that these are acceptable.
- Divisions 1 and 2 jointly organised a CIE Tutorial and Expert Symposium on visual appearance fundamentals and measurement, in Prague, Czech Republic, from 5 to 7 September 2016. This was an extremely successful event, with excellent attendance from a range of disciplines and a high standard of papers and posters covering topics such as new measurement instrumentation, visual perception, product evaluation and quality control.

- The Division met in Melbourne on 7 March 2106 in conjunction with the CIE 2016 conference on lighting quality and energy efficiency. The meeting was attended by Teresa Goodman (Country Member for the UK).
- A total of 17 Division 2 Technical Committees (TCs) met on 8 and 9 March 2016, again linked with the CIE 2016 conference on lighting quality and energy efficiency. These covered a range of topics, ranging from the highly specific (measurements for various individual SSL products) to the more fundamental (uncertainty evaluation for coloured LEDs, goniophotometry, array spectrometers and integrating sphere techniques). UK representatives are actively contributing to the work of most of these TCs.
- Two TCs are nearing the end of their work and are now going through, or being prepared for, the AD stage: TC2-29 Measurement of detector linearity and TC2-49 Photometry of flashing light.
- A number of new TCs and Reporterships were established during the year:
  - TC 2-81: Update of CIE 065:1985 (Absolute radiometers)
  - TC 2-82: Revision of CIE S014-2
  - TC 2-83: CIE Standard on test methods for OLED light sources
  - TC 2-84: Recommendations on LED package test data reporting
  - TC 2-85: Recommendation on the geometrical parameters for the measurement of the Bidirectional Reflectance Distribution Function (BRDF)
  - TC 2-87: Broadband UV LED radiometric measurements between 320 nm and 420 nm
  - R2-76 TN on measurement uncertainties for testing of LED Lamps, Luminaires and Modules
  - R2-77 Measurement of quantities relating to photobiological safety of lighting products
  - R2-78 Investigation of the need for documentary guidance relating to 0°:d (d:0°) reflectance instruments
  - R2-79 Measurement of total transmittance, diffuse transmittance, and transmittance haze
- Two TCs and two Reporterships were closed:
  - TC2-71 CIE Standard on Test Methods for LED Lamps, Luminaires and Modules
  - TC2-73 Measurement of Quantities Relating to Photobiological Safety of Lighting Products
  - R2-56 Monitoring Progress in Regional Metrology Organizations (RMOs)
  - R2-68 Measurement of light output degradation of LED light source
- Much of the work of the Division continues to be focused on the measurement and characterisation of solid state lighting (SSL) products, particularly LEDs, and on topics relating to the use of measurement instruments and measurement uncertainty. Particular aspects currently being considered, either within TCs or Reporterships, are:
  - Electrical and/or thermal measurement and control for LEDs
  - Practical approaches to uncertainty evaluation for industrial applications
  - Methods for correcting for factors such as spectrometer stray light
  - Classification system for illuminance and luminance meters
  - Photobiological safety evaluations
  - Measurement of visual effect materials
  - Standard illuminants for SSL applications
  - Recent developments relating to fundamental measurement methods
- Division 2 was highly active in the development of the CIE strategy for future research and several of the priority topics identified have a strong 'measurement' theme. The Division also

maintains its own list of additional topics, which complement those in the higher level strategy, including uncertainty evaluation, calibration and use of complex measurement instrumentation (ILMDs, array spectrometers etc.), methods for visually-complex materials, and test methods for SSL.

- The next meeting of Division 2 will be held in Jeju Island, Korea, in October 2016, in conjunction with the CIE Midterm Session. Division 2 is also planning a tutorial on CIE S025 LED Lamps, LED Luminaires and LED Modules Test Standard, in March/April 2017, to be held at METAS in Bern, Switzerland.

Full details of recent activities within Division 2, including details of all the Technical Committees and Reporterships, are available on the Division 2 website: <http://div2.cie.co.at/>

#### Active Technical Committees + UK Members

JTC-02 (CIE-CCPR)	Principles Governing Photometry	Teresa Goodman (TC Co-chair)
TC2-29	Measurement of detector linearity	Teresa Goodman
TC2-47	Characterisation and calibration methods for UV radiometers	Teresa Goodman
TC2-49	Photometry of flashing lights	Teresa Goodman, Ian Tutt, Malcolm Richardson
TC2-50	Measurement of the optical properties of LED assemblies	Teresa Goodman
TC2-51	Calibration of diode-array spectrometers	Teresa Goodman
TC2-59	Characterisation of imaging luminance measurement devices	
TC2-62	Imaging-photometer-based near field goniophotometry	
TC2-63	Optical measurement of high-power LEDs	
TC2-64	High speed testing methods for LEDs	
TC2-65	Photometric measurements in the mesopic range	Teresa Goodman TCC
TC2-67	Photometry of lighting and light-signalling devices for road vehicles	
TC2-69	CIE classification system of illuminance and luminance meters	Teresa Goodman
TC2-72	Evaluation of uncertainties in measurement of the optical properties of solid state lighting devices, including coloured LEDs	Teresa Goodman
TC2-74	Goniospectroradiometry of optical radiation sources	Teresa Goodman
TC2-75	Photometry of curved and flexible OLED and LED sources	
TC2-76	Characterisation of AC-driven LED products for SSL applications	
TC2-77	Fundamental concepts	Teresa Goodman
TC2-78	The goniophotometry of lamps and luminaires	Teresa Goodman
TC2-79	Integrating sphere photometry and spectroradiometry	Teresa Goodman
TC2-80	Spectroradiometric measurement of light sources	Teresa Goodman

TC 2-81	Update of CIE 065:1985 (Absolute radiometers)	
TC2-82	Revision of CIE S014-2	Teresa Goodman
TC2-83	CIE Standard on test methods for OLED light sources	
TC2-84	Recommendations on LED package test data reporting	
TC2-85	Recommendation on the geometrical parameters for the measurement of the Bidirectional Reflectance Distribution Function (BRDF)	
TC2-87	Broadband UV LED radiometric measurements between 320 nm and 420 nm	

### Active Reporters

R2-52	Flicker measurement and flicker index study on SSL
R2-55	Simple practical guide for measurement uncertainty estimations
R2-56	Monitoring progress in regional metrology organisations (RMOs)
R2-57	Monitoring progress of IEC TR 62778
R2-58	Standard lamps: availability of and alternatives to commercially available incandescent sources
R2-60	Discussion on the definition of luminance/radiance
R2-61	Review of published D2 publications
R2-64	Technical Note on errors of measurement in spectrophotometry
R2-68	Measurement of light output degradation of LED light source
R2-69	TN on the validation of a near-field goniophotometer
R2-70	Guide for the field photometric measurements for the verification of lighting systems
R2-71	Towards LED based standard calibration sources for photometry
R2-72	Towards a new CIE file format for luminous intensity distributions of luminaires
R2-73	Colour Luminance File Format Specification
R2-74	Physical characterisation of new visual effects in the field of appearance of materials
R2-75	TN on the use of "Accuracy" and related terms in the specifications of testing and measurement equipment
R2-76	TN on measurement uncertainties for testing of LED Lamps, Luminaires and Modules
R2-77	Measurement of quantities relating to photobiological safety of lighting products
R2-78	Investigation of the need for documentary guidance relating to 0°:d (d:0°) reflectance instruments
R2-79	Measurement of total transmittance, diffuse transmittance, and transmittance haze

Teresa Goodman

UK Representative CIE Division 2

## Division 3: Interior Environment and Lighting Design

### Terms of Reference

Division 3 of the CIE is concerned with factors which influence the satisfaction of the occupants of a building with their environment, including the effects of both daylighting and electric lighting.

Its objectives are to study and evaluate those factors to provide guidance on relevant design criteria, to study design techniques (including relevant calculations) for the interior lighting of buildings, to incorporate the findings and those of other CIE divisions into lighting guides for interiors in general or of particular types.

### Division Officers

- Division Director Jennifer Veitch
- Division Secretary Martine Knoop
- Division Editor Peter Thorns
- Associate Director for Electric Lighting Nozomu Yoshizawa
- Associate Director for Daylighting John Mardaljevic

### Current Technical Committees / UK Members

JTC 4: (D3/D6) Visual, Health, and Environmental Benefits of Windows in Buildings during Daylight Hours

*L. Price, J. Mardaljevic*

JTC 6: (CIE-ISO) Energy Performance of Lighting in Buildings (joint working group with ISO/TC 274/WG 1)

-

JTC 7: (D3/D1) Discomfort Caused By Glare From Luminaires With Non-Uniform Source Luminance

-

JTC 8: (D1/D2/D3/D4/D5/D6/D8) Terminology in light and lighting

-

JTC 9: (D1/D2/D3/D6): Quantifying Ocular Radiation Input For Non-Visual Photoreceptor Stimulation

*TBC*

TC 3-44: Lighting for Older People and People with Visual Impairment in Buildings

-

TC 3-48: CIE Standard Method of UF Table Calculation for Indoor Luminaires

*P. Thorns TCC, L. Bedocs*

TC 3-49: Decision Scheme for Lighting Controls for Tertiary Lighting in Buildings

*L. Bedocs, S. Langdown, P. Littlefair, P. Thorns*

TC 3-53: Rev. of CIE S 008 Joint ISO\*CIE Standard: Lighting of Work Places Part 1: Indoor

*P. Thorns*

TC 3-54: Rev. of CIE 16-1970: Daylight (new TCC appointed - Alex Rosemann NL)

*F. Anselmo, J. Mardaljevic*

TC 3-55: Metrics for sunlighting and daylight passing through sunshading devices

*J. Mardaljevic*

TC 3-56: Assessment of Discomfort Glare from Daylight in Buildings

[Current Reporters \(Listed as Active\)](#)

R3-29: Variable Transmission Glazing (VTG): Current Trends and Future Prospects for Up- take by the Building Sector

*J. Mardaljevic*

R3-31: Climate-Based Daylight Metrics

*J. Mardaljevic*

[Report on Associate Director for Daylighting Contribution to Webex Meeting 26th September 2016](#)

In the last year a number of Division 3 TCs active in the area of daylighting were either completed or, if deemed inactive for too long, terminated. The currently active daylighting TCs in Division 3 (including joint TCs) are:

JTC 4: (D3/D6) Visual, Health, and Environmental Benefits of Windows in Buildings during Daylight Hours

TC 3-54: Revision of CIE 16-1970: Daylight

TC 3-55: Metrics for sunlighting and daylight passing through sunshading devices

TC 3-56: Assessment of Discomfort Glare from Daylight in Buildings

The small number of active TCs in daylight-related areas was noted as a concern in previous D3Exec. (Webex) meetings, and various means to address this worrying trend were discussed. It was suggested that CIE could initiate a two-pronged approach to help encourage wider participation: both 'top-down' and 'bottom-up'.

The 'top-down' part would entail, amongst other things, a manifest statement from the Central Bureau and/or current President explaining the benefits of participation in both CIE Technical Committees and CIE conferences. Any such statement should be formulated to appeal

in particular to academics, many of whom it would appear see little value at present in joining CIE TCs or submitting papers to CIE conferences. For example, the overwhelming majority of CIE conference papers do not appear in any of the on-line search engines or citation databases. This lack of visibility serves as a positive discouragement to academics who are increasingly being assessed against measures of 'impact' including citation rankings, e.g. Google Scholar.

The 'bottom-up' part could comprise a number of grassroots strategies where CIE members/officers make use of opportunities to directly promote participation in CIE TCs. Experience has shown that face-to-face meetings and gentle, but persistent, encouragement are likely to be more effective than impersonal/un-targeted methods. For daylighting, the next VELUX Daylight Symposium (3<sup>rd</sup>-4<sup>th</sup> May 2017, Berlin)<sup>1</sup> presents such an opportunity to showcase the valuable work carried out by the various CIE Technical Committees. The theme of the symposium is "*Healthy & Climate-Friendly Architecture – from knowledge to practice*". I have contacted the organisers to suggest that a presentation on the work of TCs by a CIE Officer would be entirely in keeping with the "*from knowledge to practice*" theme of the event. The initial response to this suggestion was encouraging.

Division 3 Webex meetings have also discussed the possibility of making a selection of historical CIE conference papers freely available on the CIE website as a means of bringing attention to this often overlooked resource. This suggestion was prompted by a recent personal experience where I happened to, quite by chance, learn of a 1955 CIE conference paper [1] that challenged a long-held tenet of faith in the daylighting community. Having heard about this paper, it took some time to locate a copy – Leo Trausnith very kindly sent me scan of the paper. This 1955 paper does indeed make a very compelling case that a fundamental aspect of daylighting science (i.e. relative versus absolute measures of daylight) was either misunderstood or misrepresented [2]. One wonders how many other such ‘gems’ may be hidden away in the CIE archives.

## References

- [1] R. O. Phillips. An historical outline of the concepts and terminology of daylight. *Proc. CIE v2, Zurich, Switzerland*, 1955.
- [2] J. Mardaljevic. Opinion: Inconvenient, or simply overlooked? *Lighting Research and Technology*, 48(5):520–520, 08 2016.

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## Division 4 / 5: Lighting for Signalling and Transport

The Current Terms of Reference of Division 4 are:

*To study lighting and visual signalling and information requirements of transport and traffic, such as road and vehicle lighting, delineation, signing and signalling for all types of public roads and all kinds of users and vehicles, and visual aids for modes other than road transport.*

Divisional Officers:

Director: Ron Gibbons(USA)  
Associate Directors: Yandan Lin (CN) Dionyz Gasparovsky (ST)  
Secretary: Maurice Donner(NL)  
Editor: Nigel Parry (GB)

The primary aim of the work of the Division is to enhance safety in transport by the publication of relevant technical reports and standards. The Division currently has several active technical committees working on a wide variety of topics.

### Proposal to combine Division 4 and Division 5

In an effort to streamline the operations of the CIE, it is being proposed that the efforts of Division 4 and Division 5 be combined into a single Division. This will reduce overlap between the Divisions and allow for potentially quicker response to efforts. We acknowledge the loss of Division members and the potential for lower participation from organizations with fewer divisions. However in the long run it is believed that this will provide a more functional outcome for the CiE.

The proposal is as follows:

- 1) Division 4 is renamed "Transportation and Exterior Applications". The terms of reference are:

To study procedures and prepare guides for the design of exterior lighting and signalling including work, recreation and transportation areas.

- 2) Division 5 is closed with the follow TC changes:
  - TC 5-28: Guide on the Limitation of the Effects of Obtrusive Light Becomes TC 4-53
  - TC 5-26: Guide for the Lighting of Sport Events for Colour Television and Film Systems Becomes TC 4-54
  - TC 5-21: A Guide to Urban Lighting Master planning Becomes TC 4-55
  - TC 5-20: Guide for Sports Lighting Becomes TC 4-56
- 3) The Management Teams for both Division 4 and Division 5 resign and a new management team for the combined Division be established.
- 4) The new Division 4 establish 3 Focus Areas (each managed by an Associate Director):
  - a. Fundamentals in outdoor lighting
  - b. Lighting and signalling for transport
  - c. Exterior applications
- 5) Establish an alternate division member category to allow a country to appoint 2 members of the Division; one primary and one secondary.

### Review of last Conference

The CIE Light Quality and Energy Efficiency conference was held at Sofitel, in Melbourne 3-5<sup>th</sup> March 2016, which was followed by the annual meeting of the Division and associated Technical

Committees. The UK delegate, Nigel Parry attended: he was also present in his capacity as Divisional Editor.

#### Conference Review:

There were at least 50 papers on lighting with a few GB presentations during the conference. Steve Fotios had a couple of papers but the road lighting papers were only around 10.

Conference numbers were less than expected with around 200 delegates from around the globe.

#### Division 4 Report:

#### Technical Committees:

The following TCs met in Melbourne at the Treasury Gardens hotel, and where I attended the meeting, a short comment on each follows in order of the TC number.

- TC4-33 Discomfort & Disability Glare in Road Lighting
  - Stephan Volker new chair.
  - Outlined new structure of report developing them on from the original.
  - To determine a method for discomfort glare assessment.
  - An array of LEDs could be considered as a single source for drivers due to viewing angle and as long as led were close to each other. For pedestrians viewing directly a possible two step increase was likely
  - Regarding Spectral response suggested that blue cone sensitivity could be considered with CCT above 4000 K
- TC 4-40: Requirements for Retroreflective Traffic Signs & Guide to Properties and uses of Retroreflectors at night
  - It was noted that TC4-40 work has been completed and edited and report is ready to publish. However the committee had been closed and was re-convened to agree the report.
- TC 4-46: Roundels 300mm
  - It was noted that TC4-46 work has been completed and will be forwarded for editing.
  - There were 4 remaining committee members who met to agree the final version.
  - A presentation on 'universal design traffic signal' by Taro Ochiai: up to 5-10% people are yellow/red colour blind, so "on" traffic signals it can be a problem. Look at perceptible design for options to identify red more easily.
- TC4-47 Application of LED's in transport lighting and signalling
  - The chair Steve Jenkins confirmed that this report is two reports, one for road lighting and the other for signs & signalling and the signalling report is complete and will be forwarded for editing. So the meeting looked only at street lighting,
  - Steve went through the current draft 9 and a few points were noted for amendment/updating.
  - Requires update on vibration effects/standards and on weight limits of columns and brackets
- TC4-50 Road Surface Reflection
  - Giuseppe Rossi chaired meeting and noted Cyril Chain is co –chair for application part

- Reviewed draft and data. Data on road performance of aged roads will be added
- A bid for EMPIR funding is proposed with Div. 4 support. The project is titled 'Research on road surfaces for smart & efficient road lighting'.
- Anecdotal reports suggest that road surfaces settle after two years and actually appear brighter. More work to be done to identify values.
- If agreed then a 2<sup>nd</sup> CIE symposium on Road Surface reflection will be held in France (Cyril to organise)
- TC 4-51: Optimization of Road Lighting
  - Pal Larsen is the new chair.
  - Review of the draft report and comments that had been supplied to date took most of the meeting.
  - Substantial discussion and then changes were agreed
  - It is hoped to complete next year.
- TC4-52 Lighting for Pedestrians - new empirical data
  - Steve Fotios chaired meeting
  - 3 strands of work, looking at the needs of pedestrians, costs and benefits, standards around the world. Steve is producing an early draft.
  - WebEx meeting to be held in 2016
- TC4-53 Tunnels Lighting Evolution
  - Raoul Lorphevre is the chair.
  - Outlined approach using new 3D software to improve predictions of weather, sunlight and reflections and how they impact on tunnel lighting design.
  - Outlined workplan and proposed meeting and early draft in May or June.
- TC4-54 Lighting for the Elderly
  - Maurice Donners is chair of committee and opened meeting
  - Plans for this year to review existing literature.
  - Requested any surveys in countries about elderly drivers attitude to driving a night.
  - From this produce a GAP analysis to see what further research maybe required.
- JTC 01 Mesopic Lighting in Outdoor Lighting.
  - Tatsukiyo Uchida chaired meeting in Stuart's absence although Stuart Mucklejohn tried to join meeting by WebEx, but due to poor internet connections at the hotel it was problematic.
  - Teresa Goodman outlined that WG2 guidelines for mesopic for street lighting only. Local luminance has greatest effect on adaption and definition of field of view.
  - Outlined the Tech Note, that provides a guidance on using calculations for designers not to overuse the mesopic affect and will be circulated in few weeks.
  - TU presented the WG1 draft report and proposed final draft will be ready by Q1 2017. A number of researchers raised concerns about use of Mesopic for drivers, especially for higher speeds.

- Last WebEx meeting was in October next one is due in May 16 and followed by one in November 16 and another in April 17? Next TC meeting will be Korea Oct 2017.

## Division 4 Meeting

### Session 1

Ron Gibbons opened the meeting and introduced the officers and asked all attending to do the same.

A number of reports were provided by the DD, AD's, Secretary and Editor. In addition reports on liaison bodies were provided

A review of the current documents was carried out following the meeting with technical reports being agreed to be withdrawn, reviewed or confirmed. RG proposed that CIE 115 should have an annual review

It was agreed that the Division will develop its own research strategy and that researchers will propose projects and they will be co-ordinated and agreed at the annual meeting. NP agreed to be Reporter for this and co-ordinate the list.

A fuller list was developed and will be made available on Coll Tool.

### Session 2

Ron chaired the session.

Dionyz provided the Document Review:

Reporter 4-50 on reviews (on Coll Tool) and advised that procedures in line with CB. SO that any document review will have a comment on any reports 5 years or older will have a review date. Dionyz had nearly completed a review of every Div4/5 related report and is categorizing them accordingly. So some are current need no update, some require an update and others can be archived or deleted. A full list will be available in Coll Tool.

Reports from Div. Members:

Steve Jenkins advised that ANZ are still updating their standards and are looking to rate the part 5 of En13210 for incorporation

Taiwan & Turkey Gov want to change to LED street lights, so a basic spec has been established. This is very simple but should enable some filtering of products.

TC progress not in Melbourne:

TC4-15 Road Lighting Calculation – planned to publish in 2016.

TC4-45 Performance assessment method for Vehicle Headlamps – no input

Research Forums

TC4 Technical Forum - Cyclists

- Steve Fotios basically outlined a few technical reports on guidance for lighting for lighting for cyclists.
- Also on his own University studies on cyclists and one finding is that cycle lighting is negative on a lit road

CIE 115 – Update discussed – option of energy efficiency and saturated colour to be an addendum (WG set up to review)

A summary of Reporters and Liaisons updates were heard and written reports are located in Coll Tool, key ones are listed below:

R4-47 Led billboards – review TC in Korea

R-48 Intrusive Light deleted!

R4-49 High Speed Lighting Flicker reportship - Chao Hua Wen ITRI Taiwan report next year.

Research Topic Review:

With CB producing a top ten list of research subjects it was proposed that Div. 4 should produce its own key areas of research. A list of proposed topics for on-going and future research is to be compiled and published through Coll Tool and possible other media (NP to compile & keep updated)

New Items:

New Technical Committee/Forums/Reporters:

TC4 XX (CIE 154) Lighting Maintenance

TC4 XX Roundels

TC4 XX Retro Signs

RF4 XX Phantom array effects of vehicle rear lighting

D4/D5 Combination

D5 held a lively meeting to discuss the proposed merger and an informal vote of D4 took place. Both Divisions voted for the merger.

Discussion on associate members of a division, will be discussed with board.

#### [Future Division 4 meetings](#)

The next meeting of will take place in South Korea (Jeju Island)

In October 2017 on 'Lighting Quality & Energy Efficiency' TC meetings 20-27 October 2017

2018: TBD

2019: Quadrennial (USA Washington DC)

[Nigel Parry](#)

[UK Representative - CIE Division 4](#)

UPDATED LIST WILL BE IN COLL TOOL

Active Technical Committees			
TC	Subject	Comments	UK Rep
15	Roadlighting calculations	Rescheduled to complete 2013	
21	Interference by Light with Astronomical Observations	Decided to wait until TC5-28 is complete	
32	Surface Colours for Traffic Signs	On Going	
33	Discomfort Glare in Road Lighting	Been little activity - ongoing	
36	Visibility Design for Roadway Lighting	Completed	
40	Requirements for Retroreflective Traffic Signs	Report returned to author for amendments	
45	Performance assessment method for vehicle headlamps	On going	Terry Carter, Geoff Draper
46	300 mm Roundel signals	Report returned to author for amendments	Hugh Barton
47	Application of LED's in transport lighting and signalling	Two drafts exist – road lighting and signalling. Will be ready in 2014	Hugh Barton, Ian Tutt
48	White light in road lighting	Edited and awaiting vote	Steve Fotios
49	Guide to the properties and uses of retroreflectors at night	Closed	
50	Road surface characterization for lighting applications	On going	
51	Optimization of road lighting	New chair appointed	
52	'Lighting for Pedestrians'	Following workshop new TC set up with Steve Fotios as chair	
53	Lighting for the Elderly	TOR to be established	
JTC1	Mesopic Vision	On going	
JTC2	Merge TC2-67 with D4	Consider Joint committee?	

Active Reporters		
R	Subject	Comments
34	Retroreflective and other passive devices as Energy Savers	Bob Parks - No report
35	Crime and Road Lighting	Otto Letamendi will combine into new TC 4-52
36	CEN/TC169,Lighting Applications	Axel Stockmar new standard out this year EN13201
37	CEN/TC226, Road Equipment	Pentti Hautala – No report
38	IAU (International Astronomical Union)	Elizabeth M. Alvarez del Castillo report reced
39	GTB (Association for the Preparation of UNECE Automotive Regulations)	Ad de Visser
40	Lighting for elderly	Axel Stockmar and Cyril Chain. Proposed to move towards new TC 4-53 ( TBC)
41/42	LUCI (Lighting Urban Community International)	Cyril Chain reported
42/43	PIARC	Eric Dumont reported
44	IALA (International Association of Marine )	Malcolm Nicholson reported
4x	Enabling technologies for energy savings.	Pål Larssen – link to TC4-51

46 Raoul Lorphere GLA global lighting association – looking at ISO 274 – proposed to close reportership

## Division 6: Photobiology and Photochemistry

The Terms of Reference of Division 6 are:

*To study and evaluate the effects of optical radiation on biological and photochemical systems (exclusive of vision).*

The work of Division 6 is directly related to the health of people and more generally to the ecosystem. It considers both the beneficial and detrimental implications of exposure to optical radiation.

### Division Officers:

Division Director:	John O'Hagan (UK)
Division Secretary:	Luke Price (UK)
Division Editor:	Eric Liggins (UK)
Associate Directors:	Karl Schulmeister (AS) David Sliney (US) Shu Takeshita (JP)

- The annual meeting of Division 6 took place on 15<sup>th</sup> September 2016 by WebEx. 10 people attended: the UK was represented by John O'Hagan, Luke Price, Eric Liggins and Michael Lynn.
- During the year, the following was published:  
219:2016 Maintaining Summer Levels of 25(OH)D during Winter by Minimal Exposure to Sunbeds: Requirements and Weighing the Advantages and Disadvantages
- The next annual meeting is intended to take place in conjunction with the CIE meeting in the Republic of Korea in October 2017.

### Status of Technical Committees

#### TC6-49 Infrared Cataract (Tsotumo Okuno)

A report had been received and was available on CollTools. The TCC will soon finish addressing the comments on the ED and report to the CB.

#### TC6-52 Proper Measurement of Passive UV Air Disinfection Sources (Richard Vincent)

A report had been received and was available on CollTools. The TC is at a similar stage to TC6-49.

#### TC6-64 Optical Safety of Infrared Eye Trackers Applied for Extended-Durations (David Sliney)

A report had been received and was available on CollTools. The TCC would soon finish addressing the comments and then report to the DD.

#### TC6-66 Maintaining summer levels of 25OH vitamin D during winter by minimal exposure to artificial UV sources; requirements and weighing the (dis)advantages. (Ann R. Webb, Secretary Ad Brand)

Technical Report CIE 219:2016 "Maintaining Summer Levels of 25(OH)D during Winter by Minimal Exposure to Sunbeds: Requirements and Weighing the Advantages and Disadvantages" was published, completing the work of the TC.

#### JTC-4 Visual, Health, and Environmental Benefits of Windows in Buildings during Daylight Hours (Martine Knoop-Velds)

A report had been received and was available on CollTools by the outgoing chair of the JTC, Martine Knoop-Velds. In the beginning of 2015 Fabio Bisegna had to resign as co-chair and D6 is still to

provide a new co-chair. In Division 3, Martine Knoop had to resign as TCC in November 2015. Jan Wienold is proposed as new TCC.

To participate in the work of JTC-4, Division 6 has to nominate a co-chair. Theoretically JTC members David Sliney, LP, Tongsheng Mou and Maria Ámundadóttir are potential candidates, along with potential new JTC members. DS6 proposed to seek to find a D6 candidate to be co-chair following Jan Wienold being confirmed as Chair for D3.

#### JTC-5 Joint Technical Committee to Revise CIE S009/IEC 62471 (John O'Hagan)

A report had been received and was available on CollTools. Over the year two meetings were held followed by editorial meetings. Delays had enabled a review for consistency with IESNA/ANSI RP27.1 and RP27.3. The current draft will be circulated in the JTC for a meeting together with the IEC TC76 meeting in Beijing in October 2016. The formal approval process is planned to run in parallel between CIE and IEC, for possible publication by the end of 2017.

#### JTC-8 International Lighting Vocabulary (Peter Zwick)

Although this is not listed as a D6 activity, all CIE Divisions are involved in this JTC. The JTC aim is IEC adoption of the existing ILV, with any modifications that are required. DD6 noted that D6 did not have many definitions in this report, but the definitions had been reviewed term-by-term by relevant professionals in CIE and IEC.

#### JTC-9 Quantifying ocular radiation input for non-visual photoreceptor stimulation (Luc Schlangen, Secretary Luke Price)

A report had been received and was available on CollTools. DS6 commented that early in July 2016 the JTC was formally declared active. Previously, three meetings occurred via Skype in which a working draft for a standard was prepared and updated. The working draft of the standard defines the spectral sensitivities or action spectra for the five human photoreceptors that relate to the rods, S-,M- and L-cones and to the intrinsically-photoreceptive retinal ganglion cells. This makes it possible to quantify ocular irradiance with respect to its ability to stimulate individual photoreceptors that can contribute to eye mediated non-visual responses to light.

#### [Progress reports from Reporters](#)

#### R6-44 Optical Radiation Hazard Measurements in the Workspace (David Sliney, Robert Angelo)

No report had been received for this new reportership. DD6 believed this should not take too long, as the previous TC had folded close to reporting due to a lack of complete unanimity during the voting. It had been decided the majority findings of the TC could be best captured with a DR rather than the work collating it in a report being lost.

#### R6-43 Illuminators for Treatment of Infant Hyperbilirubinemia (Graham Hart, Michael Lynn)

A report had been received and was available on CollTools. The DRs hope to produce a report for EL by the end of September 2016. DD6 noted that D6 was desperately waiting for this.

Michael Lynn spoke about the need for this report. The original report which the DRs adopted could not be published as it lacked strong evidence. The question of which wavelength to treat jaundiced babies with is complex. The present blue light does work, but longer wavelengths may be better. Blue light has been more recently found to stress premature and full-term babies and higher mortality rates are associated with blue light treatment, although it cannot be shown that this is causal.

The DRs had discovered the importance of dermatologists opinions on the long term effects of blue light treatment, and there were concerns being expressed about the adverse effects in this community. Although manufacturers may have little incentive to change the treatment lamps, the

DRs consider longer wavelengths would be as effective as the present lamps, and potentially less harmful, and they would make use of the additional concerns from dermatologists to make the case.

John O'Hagan

UK Representative CIE Division 6

Director, Division 6

20 October 2016

## Division 8: Image Technology

The Terms of Reference of Division 8 are:

*To study procedures and prepare guides and standards for the optical, visual and metrological aspects of the communication, processing, and reproduction of images, using all types of analogue and digital imaging devices, storage media and imaging media.*

The overall goal of Division 8 can be summarized as seeking to provide methods for better understanding the components of imaging systems with a view to providing both the professional user and home picture-taker with consistent colour images over a wide variety of media.

The most recent formal meeting of CIE Division 8 was held as part of the CIE Session in Manchester in July 2015. Approximately 33 people attended (8 via the internet) including seven Country Representatives, six Technical Committee Chairmen and three Reporters. The next CIE Division 8 meeting will be host in San Diego in November 2016

In new released CIE Research strategy, *Reproduction of Measurement of 3D objects*, recommended by CIE D8, has been listed as one of Top Priority Topics.

### Status of Technical Committees

TC8-07 Multispectral imaging	A Working Draft report is in committee ballot.
Abstract: This technical report describes the basic model of multispectral imaging technology followed by the requirements and examples of multispectral image formats suitable for colour imaging applications. Four example formats: JPEG2000, Spectral Binary File Format, Natural Vision, and Multispectral image file format AIX, are introduced and compared in typical use cases. The specifications of those formats, except for JPEG2000 are provided in the Appendix.	
TC8-09 Archival colour imaging	Now closed and new TC ,TC 8-15, is established
TC8-10 Office lighting for imaging	Now closed and moved to a Reportership R 8-14.
TC8-11 CIECAM02 mathematics	Now closed and new Joint TC is planned
TC8-12 Image and video compression assessment	Active. Working Draft Report near completion.
TC8-13 Colour gamuts for output media	Active – meets regularly by WebEx
TC8-14 Specification of spatio-chromatic complexity	Active – TC meeting was hosted in Prague in Sep 2016
TC 8-15 Archival colour imaging	Active

### Status of Reporters

R8-09 Output linearization methods for displays and printers	Report approved
Report Summary: The R8-09 Output Linearization Method is appropriate for the rgb data output on printers, in offset printing, on displays, and for data projectors with different reflections on the projection screen.	
Within R8-09 the rgb file data are interpreted in a special colorimetric manner with a linear relation to the CIELAB data $L^*$ , $C^*_{ab}$ , and $h_{ab}$ values. If a colour output device interprets the rgb data according to R8-09, then it is called an $rgb^*$ colour device. Any two $rgb^*$ colour devices produce a colorimetric affine match in CIELAB with equal hue angles $h_{ab}$ and usually different values in	

lightness  $L^*$  and chroma  $C^*_{ab}$ . This colorimetric affine match is different compared to the usual colorimetric match with equal CIELAB data on different devices. The usual colorimetric match produces a clipping of colour areas and this disadvantage disappears with the colorimetric affine match.

There are several advantages of the colorimetric affine match with the  $rgb^*$  colour devices:

1. The whole device gamut is used on any  $rgb^*$  device.
2. The hue output remains constant on any  $rgb^*$  device.
3. The elementary hue, for example Red as neither yellowish nor bluish, is produced for  $rgb^*=(1,0,0)$
4. Equal relative spacing in CIELAB is realized on any  $rgb^*$  device.
5. There is no clipping of colour areas on any  $rgb^*$  device and the output may be called a trusted output.

If the colorimetric affine match is realized for any  $rgb^*$  device according to R8-09, then

1. Many user wishes of DIN 33872-X are solved.
2. The undefined colour output properties change to the  $rgb^*$  device output property.
3. According to ISO/IEC 19797 the intended startup stage for colour management is reached.
4. The output accuracy is by a factor 5 higher compared to the ICC encoding with 8 bit in CIELAB.

A disadvantage may be the usually different chroma and lightness on two  $rgb^*$  devices. However, the colour gamut of two colour devices is usually different. Based on this device property the colorimetric affine match seems an appropriate solution which solves for example the many user wishes of DIN 33872-X.

R8-10 Full-reference image quality metrics: classification and evaluation	Report approved
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Report Summary: The wide variety of distortions that images are subject to during acquisition, processing, storage, and reproduction can degrade their perceived quality. Subjective image quality evaluation is time-consuming, expensive, and resource-intensive. Objective methods do not have these shortfalls. One type of these methods, image quality metrics, has become very popular and new metrics are proposed continuously. This report aims to give a survey of full reference image quality metrics. These image quality metrics have been classified into different groups. Furthermore, image quality metrics from each group were selected and evaluated against a state-of-the-art quality database, the Colourlab Image Database: Image Quality ([CID:IQ](#)).

R8-11 Colour image reproduction for 3D printing	Report approved
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Report Summary: the current technologies in full colour 3D printing technology were summarised. Special focus was put on colour image reproduction frameworks using 3DPTM and PolyJetTM printing engines. It was found that with different printing technology, structure and sub-processing for colour image reproduction can be very different although colour management is always an essential step for both frameworks. For each system, conventional technology of cross media colour reproduction had been applied to transform colours in 3D objects from one media (3D camera or display) to another (3D printer). Flat colour charts were used for either developing a colour profile or evaluating the performance of the colour reproduction of 3D objects. Clearly, appearance in flat colour sample cannot truthfully represent appearance of 3D object. For reproducing 3D objects, when conventional colour reproduction technology was applied, a number of limitations were found and discussed in this report.

For the 3D printing industry, although colour reproduction is highly desired, there is still a lack of

<p>technology to truly measure and reproduce the colour-appearance of any 3D printed objects. Therefore, we recommend establishing a new Technical Committee to comprehensively investigate methods for evaluation and reproduce colour appearance for 3D printed objects using both subjective and objective methods.</p>	
R8-12 3D multi-view image/video colour data format conversion and quality control	Report approved
<p>Report summary: To report on methodologies of colour data format conversion of 3D multi-view image/video for 2D/3D display and their effect on 2D/3D image and colour quality, with the aim to identify opportunities for future CIE Division 8 activity in this field.</p>	
R8-13 Common colour appearance	Active
<p>Terms of Reference: To study the topic of common colour appearance to determine whether people mean the same thing when they use this term. The report will collect examples of what people refer to as common colour appearance including for displays, printing systems and brand management. The report will also identify some counter examples.</p>	
R 8-14 Office Lighting for Image	Active
<p>Term of Reference: To publish a Technical Note on the spectral power distribution and illumination levels used to view images in office lighting conditions, collected through the activity of TC8-10</p>	
R 8-15 A survey on Quality Metrics on Stereoscopic Imaging	Active
<p>Terms of Reference: To publish a Technical Note to describe the state of the art of the Stereoscopic Image Quality Assessments (SIQA), and psycho-physical experiments to evaluate the Metrics on Stereoscopic Imaging.</p>	

Dr Kaida Xiao  
19 October 2016

## APPENDIX A

### THE CIE & NIC

Each country participating in the work of the International Commission on Illumination (the CIE) forms a National Illumination Committee (NIC). This Committee is representative of all bodies in that country which have an interest in light and lighting.

The CIE:

- provides an international forum for the discussion of all matters relating to science technology and art in the fields of light and lighting
- co-ordinates the international activities of individuals and organisations, to identify outstanding and fundamental issues pertaining to light and lighting and to find solutions
- develops basic standards for measurement and application design
- publishes Technical Reports and Standards and maintains liaison with other international standards organisations.

The CIE technical programme is divided into seven Divisions covering Vision and Colour; Physical Measurement of Light and Radiation; Interior Environment and Lighting Design; Lighting and Signalling for Transport; Exterior and Other Lighting Applications; Photobiology and Photochemistry; and Image Technology. Each Division establishes Technical Committees (TCs) with international representation of experts, to undertake specific tasks. Each TC is disbanded when the work is complete.

The CIE holds a Sessional Conference every four years, which reviews the latest developments in the field and plans the work of the divisions and their Committees for the next quadrennium.

The CIE Central office is based in Vienna. The Secretary General and her assistants are responsible for the administration associated with co-ordinating the activities of all member countries and for publishing the Commission's Technical Reports and Standards.

The CIE is supported through the time and expertise of individuals, most of whom are associated with companies, institutions and organisations interested in light.

The CIE is supported financially by each country's National Illumination Committee which contributes according to a Central Office allocation based on the scale of assessments for the contribution of Member States of the United Nations Organisation, but with modified upper and lower limits. Each NIC depends on contributions from supporting organisations, income from the sale of published Technical Reports and Standards and from the organisation of seminars.

The National Illumination Committee of Great Britain is supported by sponsoring and co-operating organisations. Many universities and colleges participate, as do Government Departments and official bodies interested in or concerned with the design, development and use of light. There are also representatives of the lighting industry as well as independent consultants and architects representing professional bodies.

The NIC selects and sends delegates to the sessions of the CIE. It keeps in close touch with developments throughout the world, both in research and in practical applications, by personal contact as well as via the issues of the CIE News and CIE Division Activity Reports. It also ensures that the British contributions are made known and properly recognised in other countries.

Great Britain, one of the founder members of the CIE, established its National Illumination Committee in 1913 and since then has played a major part in the development of the Commission. The original decision to establish the CIE was considerably influenced by Leon Gaster, the founder of the British Illuminating Engineering Society, now the Society of Light and Lighting.

## APPENDIX B

### CONSTITUTION OF THE NATIONAL ILLUMINATION COMMITTEE AT 30 SEPTEMBER 2016

#### Officers and Trustees

Chair	Teresa Goodman
Vice Chair	John O'Hagan
Honorary Secretary	Peter Raynham
Honorary Treasurer	Nigel Parry
Secretariat	
Executive Secretary	Allan Howard 4 Symonds Green Road, Stevenage, Herts SG1 2HA

#### Sponsoring Organisations

Institution of Lighting Professionals	Stuart Bulmer Nick Smith Allan Howard
Society of Light & Lighting	Brendan Keely Peter Raynham John Fitzpatrick

#### Cooperating Organisations

Ceravision Limited	Stuart Mucklejohn
College of Optometrists	Alan Smith
Colour Group (Great Britain)	Vien Cheung
Public Health England	John O'Hagan
International Association of Lighting Designers	Kevin Theobald, Emma Cogswell
Lighting Industry Association	Tariq Malik
National Physical Laboratory	Teresa Goodman
Society of Dyers and Colourists	Andrew Filarowski (Ronnier Luo)
Thorn Lighting Ltd	Peter Thorns
Trinity House Lighthouse Service	Alwyn Williams
OrangeTek Ltd	Nigel Parry
Qinetiq Ltd	Dr Eric Liggins
Tintometer Ltd	Dr P J Clarke
VeriVide Ltd	John Dakin

#### Participating Universities

University of Liverpool	David Carter
Loughborough University	John Mardaljevic
University of Manchester	Ann Webb
University of Reading	Geoff Cook
University of Sheffield	Steve Fotios
University College, London (The Bartlett)	Kevin Mansfield

Individual Members

Enrico Biabchi  
Mike Hall  
Gareth Johns  
Gareth Jones  
Leslie Lyons  
Martin Morgan-Taylor  
Nigel Pollard  
Nick Smith  
Ian Tutt  
Christopher Wilkes  
Michael Pointer  
Diana Del-Negro

CIE Division Representatives

Division 1	Peter Clarke
Division 2	Teresa Goodman
Division 3	John Mardaljevic
Division 4	Nigel Parry
Division 5	Merging with Div 5
Division 6	John O'Hagan
Division 8	Kaida Xiao

## Appendix C

### Reports from recipients of the 1975 bursary.

As a general principle, funds are available from the 1975 Fund to support travel and subsistence to attend CIE business meetings: this includes CIE Division meetings, CIE Board of Administration meetings, and CIE Technical Committee meetings.

Each individual who receives support is required to provide a written report (of around 1,000 words) on the event they attend, or the work they carry out, for distribution to members through the web site and these will also form part of the annual report.

## ***CIE Conference 2016, Melbourne, AU***

*Short report by Navaz Davoudian*

### ***Welcome Reception***

The welcome reception was held on 2<sup>nd</sup> of March in Bobby McGee's pub/club. It was a relaxed and informal networking session with unexpected presence of reptiles!

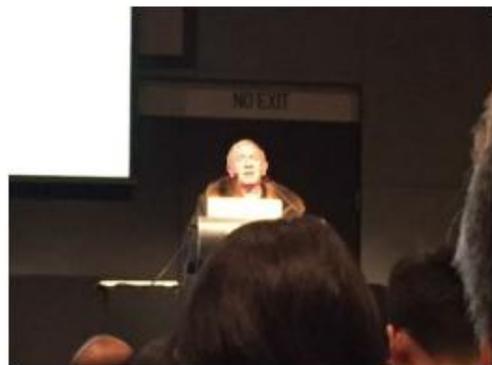


### ***First Day of the Conference***

CIE Conference 2016 was officially opened on Wednesday 3<sup>rd</sup> of March with a warm welcome from a representative of aboriginal community in Melbourne. He presented the audience with a brief history of native Australians in Melbourne. Interesting fact that the last full blooded aborigine has died in 1997!

The opening ceremony continued with welcome from CIE Australia president Tony Bergen, CIE president Yoshi Ohno and General secretary Kathryn Nield.

The first key note speaker, Bruce Ramus, talked about the quality of light in our life. The Australian lighting designer went through samples of his design work around Australia. Ramus illumination's work is about connection- creating works that are innovative, interactive and sustainable.



After coffee break I attended "Interior applications" session chaired by Steve Fotios. Apart from the first speaker who was from University of Singapore and talked about HDR imaging, other speakers were mainly master and PhD students.

The second session was on "Interior applications- Glare" chaired by Jennifer Long. The first two speakers were PhD students from Canada and Switzerland and the session finished by Maurice Donners speech from Philips, Netherland.

Here I am not going to report the details of the talks as they can be found in the conference proceedings.

### ***Second Day of the Conference***

The second day keynote speaker was Anya Hurlbert from the University of New Castle, UK. It was a very interesting talk on the human visual and non-visual responses to spectral variations in light. She spoke about her project on colour consistency using different light sources including daylight. The work was done in collaboration with National Gallery in London. Interestingly people preferred daylight and incandescent light on paintings! She also talked about her research on non visual effect of light; mood, sleepiness and melatonin level in different times of the day.

The session continued by plenary session on CIE research strategy. Top priority topics for D4 and D5 were; integrated glare metrics for various lighting applications, adaptive, intelligent and dynamic lighting, and recommendation for conditional lighting, aging population and visual impairment.

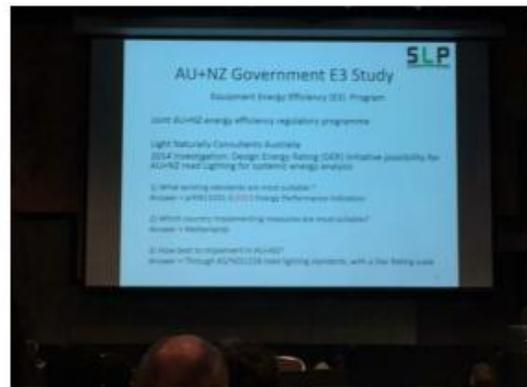
I chose "Interior applications- Glare (2)" chaired by Stephen Volker for my first session of the day. There were three talks around discomfort glare, HDR imaging, prediction of discomfort glare and a case study from Malaysia.

Posters were presented on the afternoon session chaired by Gillian Isoardi from Queensland University of Technology. Good discussions on different topics around lighting and lighting quality.

Conference dinner was held in Cargo Hall, one of the Melbourne's newest riverside purpose-built event spaces at South Wharf. It was where Tony Bergman proved that he is not only good at lighting but he is a good entertainer too!

### ***Third Day of the Conference***

The third day keynote speaker was Bryan King, an experienced lighting practitioner and authority on road lighting practice from New Zealand. He talked about his research on analysis of the design energy performance achieved by a selection of 83 lighting road schemes recently designed and installed across Australia and New Zealand covering both main roads and residential roads.



On the first session of the day after keynote speech, I attended "Exterior applications" chaired by Maurice Donners. There were three presentations, one from Merlin project presented by Steve Fotios. Second one was a study from Taiwan on luminance contrast of LED traffic signs. The final talk was from Belgium on maintenance factor.

I spent the second session on both "Road lighting" chaired by Ron Gibbons from Virginia Tech and "Visual comfort " chaired by Kevin Houser. Topics discussed were from road surface categorization to aging drivers and gaze behaviour in a daylight office space.

The conference was concluded by closing ceremony.

Report on CIE LOEE Conference and Associated Meetings, Melbourne, March  
2016  
Teresa Goodman

I attended the following meetings:

- BA meeting
- LOEE Conference
- D2 Division meeting
- D2 TC meetings for JTC-01, JTC-08, TC 2-79, TC2-50, TC2-72, TC2-80, TC2-69 and TC2-78

My overall impressions of the whole event were that it was very well organised and the technical quality of the conference and the associated meetings was high. Attendance was disappointingly low, possibly because of the location (it was a long journey for almost everyone!) but also because of the very large number of competing events relating to energy efficient lighting. It was also noted by several delegates that the timing was not ideal, being only 9 months after the sessional meeting in Manchester and falling at the end of the fiscal year for many organisations.

One of the key topics of discussion at the BA meeting was the CIE research strategy (this was also presented at the conference). This is a new initiative for the CIE, although several of the Divisions have been working to develop their own research priorities for a number of years. The idea is not just to provide a means of prioritising the work within the Divisions but also to raise the profile of CIE's research activity to relevant stakeholders. It also gives external stakeholders a route by which they can comment on, and influence, CIE's work in a more structured way than has previously been the case. The process by which this research strategy has been developed has been very much bottom-up (i.e. it has come from the Division members rather than the Division management teams or the BA members), and each of the Divisions has worked independently, with the previous VPT (Yoshi Ohno) and the new one (Erkki Ikonen) taking responsibility for collating the themes from each Division into a more cohesive whole. The draft strategy is now at the internal commenting stage, but the aim is to launch it on the CIE website within the next few months. I think this initiative offers a number of positive opportunities for CIE-UK members:

1. Being able to point to a CIE document that highlights the importance of a particular area of research could be very useful support when universities and other research organisations are putting together new research proposals.
2. Being able to influence CIE's research priorities could help speed up work on topics of particular interest to CIE-UK members.
3. Greater visibility of CIE's work could help to ensure that the interests of CIE-UKs members are properly taken into account (members can get involved early on and influence the direction of the work, rather than simply responding to outcomes once nearly complete).

Other topics discussed at the BA were:

- Finances. CIE's financial situation is still 'difficult', and income for the current year already looks as though it's going to be slightly less than the original forecast due to the low attendance at the Melbourne meeting. The Board has agreed that CIE should concentrate on activities that use its particular strengths most effectively (and consistently generate good levels of income), which means expert symposia and workshops, technical publications (especially those related to 'fundamentals' rather than 'product-related') and mid-term/full-term meetings. The LOEE conferences are to be re-thought, to see how they can be clearly differentiated from the multitude of competing energy efficient lighting events.
- CIE website. This has been identified as a priority area for investment as soon as finances allow, since the current website is based on obsolete software and is no longer adequately

supported. Several quotes have been obtained for a completely re-vamped website, but this has been put on hold for the present until the financial situation improves.

- CIE's profile in the IYL was high and was boosted further by the CIE-UK video prepared for CIE2015, which was played at the IYL closing ceremony and which also won the IYL competition for the best video. Discussion is now underway for a follow-up event, an International Day of Light.
- The new 'rules' for TCs have resulted in the closure of a number of very long running TCs. Although many of these were clearly never going to get anywhere, in some cases the lack of progress was due not to lack of interest or relevance, but was because the TC had been established too early, before the topic area was sufficiently mature for there to be a realistic prospect of completing work within the expected 8 year timeframe (TCs can still continue for longer than 8 years, but the TCC cannot). In recognition of this, the BA discussed whether to introduce the category of 'Research Forum' (or similar), which would bring together those with an interest in a particular topic and facilitate exchange of ideas etc. Some of these might ultimately lead to the establishment of a TC, others might continue almost indefinitely to encourage collaboration but without any defined outcome. Details are being refined but the general principle has been agreed.
- Some countries, most notably US, are keen to restrict participation in CIE TCs only to those who are NC members. Views were strongly divided on this point and it is certain to be discussed again. I argued against it, since I feel it would not only be detrimental to CIE's work, but also be almost impossible to police effectively. I would welcome views from CIE-UK members.

The LOEE conference was obviously focussed on LEDs (applications and measurement in particular), but it also included some presentations that were much more general in nature, such as discomfort glare, sky luminance, photobiological safety evaluation and mesopic photometry. This breadth of topics is somewhat unique to CIE (most LED conferences and events are much more closely tied to applications and latest technological advances) and possibly needs to be highlighted and strengthened if a similar conference is held in the future.

The Division 2 TCs covered a similarly broad range of topics. There has been a change in emphasis for the Division over the past year, following the publication of the CIE test method for LEDs and LED products (S025); LEDs are no longer such a dominant topic (only a couple of TCs dealt with LED issues this time) and efforts are being concentrated on updating some of the fundamental documents which give guidance on basis measurement principles such as spectroradiometry, goniophotometry, luminous flux using integrating spheres and definitions of measurement quantities. CIE-UK members should contact me directly ([teresa.goodman@npl.co.uk](mailto:teresa.goodman@npl.co.uk)) for further details of any D2 TCs they are particularly interested in.

## Report on CIE Lighting Quality and Energy Efficiency Conference 2016 Steve Fotios

The conference part was three full days of research presentations.

Prior to the conference I was a member of the scientific committee. The aim of the scientific committee is to review the abstracts that have been selected, to recommend those that are suitable for papers, for posters or that should be rejected. I reviewed fourteen abstracts. There were three online meetings to discuss the submitted papers. One key discussion was the trade-off between the quality of submitted work and the need for potential attendees to have an accepted paper to help with their requests for attendance. I raised a second issue, the need for more discussion time at CIE conferences, and this led to allocation of a 30-minute slot at the end of each presentation session.

I gave two oral presentations during the conference:

1. Fotios, S., Castleton, H., Lin, Y., Yang, B. Varying facial expressions in studies of interpersonal judgements and pedestrian lighting. Proceedings of CIE 2016 conference: Lighting Quality and Energy Efficiency. 3–5 March 2016, Melbourne, Australia. 275-282.
2. Winter, J., Fotios, S., Völker, S. Gaze behaviour when driving after dark on main and residential roads. Proceedings of CIE 2016 conference: Lighting Quality and Energy Efficiency. 3–5 March 2016, Melbourne, Australia. 395-401.

The first paper described two studies associated with lighting for pedestrians. Specifically, this work focused on methodology issues, addressing questions raised by referees during peer review of previous articles. One part described a facial recognition matching experiment in which the target and matching faces had the same or different expressions: the results show that matching with different expressions is the more difficult task. The second part reported a re-analysis of a previously reported facial emotion recognition experiment: rather than analyse performance across all six expressions, as was originally done, this further analysis analysed performance for each expression individually. It was found that this did not change the conclusion that lamp spectrum does not affect facial emotion recognition. This work feeds in to TC4-52.

The second paper describes an investigation of the locations of drivers' visual fixations, data needed to characterise their state of luminance adaptation. This is a re-analysis of eye tracking recorded by others. A signal detection approach was used to compare how well several standard shapes encapsulate the locations toward which drivers look. The key conclusion of this paper is that main roads and subsidiary roads may demand different search patterns and therefore different adaptation fields. This work contributes to JTC-01.

I used my presentations to promote the CIE 2018 Research Methodology Symposium (Aalborg University, Copenhagen, Denmark, August 2018) for which I am co-organiser along with Ásta Logadóttir of SBI Denmark and an advisory committee of John Mardaljevic, Jennifer Veitch and Kevin Houser. This is the first ever CIE meeting to discuss methods rather than results. One reason I am co-organiser is that this will follow-up my previous work as chairman of TC1-80 (*Research Methods For Psychophysical Studies Of Brightness Judgements*) which led to the publication **CIE report 212:2014. Guidance Towards Best Practice In Psychophysical Procedures Used When Measuring Relative Spatial Brightness. Commission Internationale De L'Éclairage, Vienna, 2014. ISBN 978-3-902842-51-0.**

I was chairman for one conference session (Interior applications - Efficiency and visual perception quality). Prior to the conference I read the CVs and papers of the four speakers so that I could properly introduce them and describe to the audience the connecting themes. It would be useful if this was a more common practise amongst chairmen. The role of a chairman in maintaining the flow

of a session and in encouraging questions during discussion time does not appear to be well appreciated.

Despite jet lag I attended all conference sessions. Of particular interest were the following presentations:

- OP17: Peter Hansen. Glare caused by contrast between task and immediate surround: an evaluation of luminance distribution in the field of view
- OP18: Maurice Donners. A psychophysical model of discomfort glare in both outdoor and indoor applications
- OP50: Rob Van Heur. Maintenance factor for street lighting
- OP48: Maurice Donners. Road lighting for ageing drivers – a users' perspective
- P05 Lars-Fredrik Forberg. Differences in perceived brightness between high pressure sodium and led light sources

The conference was followed by three days with scheduled meetings of Division and Technical Committees. At this event I attended only Division 4 meetings: Divisions 1 and 3 did not meet, and I usually attend some of their meetings too. Within D4 there were two Division meetings and ten TC meetings.

There were two key discussions in the Division meeting: the potential merger with D5 and the research strategy. There is a proposal to merge D4 and D5: both deal with outdoor lighting applications, the merger would bring administration efficiencies, and D5 tends to be a very small gathering. In contrast, losing a division means each country loses a division member which may affect a person's ability to gain approval for travel funding. The general consensus was for a merger. A new division is likely to have three associate directors under the main director, and I put my name forward for consideration as an associate director depending on the nature of the role. The CIE research strategy is a list of the topics considered to be most in need of further research, so essentially a list of priorities. There are two parts, an overall strategy and a division strategy, the latter being discussed in the D4 meeting. As a researcher such lists are critical because they can be used to support the need for research in a funding application: conversely, the absence of a theme in such lists could be used by a reviewer to reject a funding application. Within D4 a list was made of topics considered to be in need of further work, this being updated during discussions held over the three days.

I led two TC meetings, TC4-52: Lighting for pedestrians and the cycling research forum. TC4-52 started in July 2015; at this meeting I proposed what would happen next, i.e. to focus on each discrete visual task in turn (obstacle detection, interpersonal judgements, reassurance, visibility of pedestrians etc) to address four points:

1. Is it important?
2. Data available
3. Tentative proposal of lighting quality
4. What further research is required?

I am working on the first section (obstacle detection) and will hold a webex to discuss this later in the year. The cycling research forum has not yet officially started: I presented a summary of UK policy and recent research and will be contacting others to make a plan.

Of the other TC meetings I attended, I am making a contribution to two in particular, TC 4-33: Discomfort Glare in Road Lighting (Stephan Voelker) and Lighting for the Elderly (Maurice Donners) by the provision of data and by working on their reports.

Report on CIE Tutorial and 4<sup>th</sup> Expert Symposium on Colour and Visual Appearance, Prague,  
September 2016

Teresa Goodman

As well as attending as a delegate, I presented one of the tutorial sessions, on the topic of "Fundamentals in radiometry, spectrophotometry and colorimetry", and also chaired one of the sessions during the symposium.

My overall impressions of the whole event were that it was very well organised and the technical quality of the both the tutorial and the symposium was good. Attendance was higher than expected at both events, and the breadth of expertise and interests was extremely broad, including academics with an interest in vision and cognition, metrologists, instrument manufacturers, producers of paints and special effect materials, and computer graphics. The geographical spread was similarly wide, with representatives from Europe, Asia (particularly from Japan and Taiwan), South Africa, USA and even as far afield as New Zealand.

The tutorial had the ambitious objective of presenting the many facets of visual appearance measurement (and, to a lesser extent, perception) to participants with various degrees of expertise in this field. As is usual with such events, many members of the audience were already experts in some aspects, and balancing the need to explore more complex topics in order to meet their expectations, whilst also explaining the fundamentals for those new to the subject, presented some difficulties. The day was divided into two parts, the first being a series of formal presentations on the more fundamental topics and the second being practical demonstrations of effects materials and their measurement. The lectures went well and were pitched at such a level that basic concepts such as colour, colour difference evaluation, gloss and texture were clearly presented, progressing at a good pace to more complex issues such as BRDF. The practical sessions were slightly less successful, due in large part to the high number of delegates which meant that many members of the audience could not see the effects being demonstrated. However there was ample time allowed for discussion with the presenters during these sessions, allowing delegates to explore their particular interests with the relevant experts. Overall the feedback from the tutorial was good and there was a strong suggestion that it should be held again.

The conference presented the latest research in the area of appearance, with a good mixture of oral papers and posters. The major topics were goniometric measurements and BRDF, fluorescence, characterisation of special effect (goniochromatic) materials, colour conspicuity, texture, gloss, and appearance modelling and simulation. It was clear that rapid advances have been made in the past few years not only in the ability to manufacture special effect materials on a reliable and reproducible basis (and to characterise these in such a way that the visual effect can be properly assessed), but also in the ability to model the relationship between the physical attributes of a material and the visual perception of gloss, sparkle and texture.

Full details of the conference are available in the proceedings (CIE x043:2016). The tutorial was recorded and is likely to be made available on-line. The success of both events, in terms of delegate numbers and feedback received, means they are highly likely to be held again, probably in about 3 years' time.