



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

# ACTIVITY REPORT DIVISION 8

IMAGE TECHNOLOGY

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**March 2002**

**Division Officers:**

*Director:* Todd Newman US  
*Secretary:* Dave McDowell US  
*Editor:* Mike Pointer UK

The officers can be contacted via the Division 8 web site: [www.colour.org](http://www.colour.org)

**Division Terms of Reference:**

To study procedures and prepare guides and standards for 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.

This activity report represents an overview of the status of CIE Division 8 – Image Technology at the beginning of 2001; it is the first such report issued by this Division.

The Division aims to work primarily by electronic means in order to make efficient progress. This method of working has proved worthwhile and good progress is being made in several areas.

Since its inauguration in September 1998 at a CIE Meeting held in Baltimore, US, the Division has held meetings in Warsaw, Poland (1999) as part of the CIE Quadrennial meeting and in Derby, England (2000) in association with the conference *Colour Image Science 2000*. Several of the Technical Committees met before or after the IS&T *Color Imaging Conference* in Scottsdale, Arizona in November 2001, and an informal meeting of the Division was held. It is proposed that there be a similar arrangement at the 10th IS&T *Color Imaging Conference* to be held in Scottsdale, Arizona in November 2002.

The next formal meeting of the Division will be held in conjunction with the CIE Quadrennial Meeting, 25 June – 2 July 2003, in San Diego, USA.

There follows a summary of the status of each of the committees in Division 8 – Image Technology.

## TC 8-01 Colour Appearance Models for Colour Management Applications

**Year established:** 1998

### **Terms of Reference:**

To study, develop, and recommend a colour appearance model based on CIECAM97s for use in digital colour management and to develop clear usage guidelines for common applications. Consideration is to be given to colour and engineering requirements for open colour management systems.

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### **Members:**

Belgium	M Mahy			
Japan	N Katoh*	H Komatsubara	H Motomura*	K Takemura*
	H Yaguchi			
United Kingdom	R Hunt	A Johnson*	R Luo	M Pointer*
United States	P Alessi	E Carter*	J Dalrymple*	G Dispoto
	M Fairchild	Xiao-Fan Feng	S Henley*	A Kravetz*
	G Marcu*	D McDowell*	N Moroney	T Newman*
	N Vujovic			

\*Listserver Subscribers

### **Working Programme**

Winter 2001: Create sub-committee for draft technical report

- Focus on linear chromatic adaptation transform
- Incorporate revision for chroma scaling of near neutrals
- Collect all previously agreed upon revisions

Spring 2002: Review by full technical committee

- Incorporate comments and questions
- Determine a testing and validation plan

Fall/Winter 2002: Review by larger colour science community

- Present draft technical report outside of the technical committee
- Continue testing and validation of revisions
- Final draft of technical report

### **Progress Report**

After two physical meetings in the summer of 2001 in Rochester, New York and in the fall of 2001 in Scottsdale, Arizona great progress has been made and the number of major revisions to be finalized is down to one. The primary unresolved issue remains the selection of the linear chromatic adaptation transform. The entire committee agrees that the revised model should include a linear chromatic adaptation transform but there is still no consensus about which one to use. A significant accomplishment was to gain consensus on the chroma

scaling. Additional analysis and experiments by the technical committee have supported a reduced chroma scale for the very near neutrals, although there are two possible means to implement this revision.

The committee participated in two surveys on which linear chromatic adaptation transform should be used and the votes were about evenly split between two transforms proposed by Luo, et al. and the transform proposed by Fairchild. There would appear to be a trade-off between a higher degree of backwards compatibility, the Fairchild transform, and an optimisation based on all or most available corresponding colour data sets, the Luo et al. transforms. The performance of all of the transforms is fairly similar so secondary considerations are being investigated. Analysis by Mahy revealed that there is no significant difference between the transforms based on error propagation. Hunt and Fairchild have prepared a summary document highlighting the differences between these transforms. The second survey resulted in a small preference margin for one of the Luo et al. transforms but there is still ongoing discussion of the topic.

During the physical meeting in Rochester, New York, Alessi shared her results from TC1-27 and follow-up discussions between Alessi and Fairchild have been shared with the committee as outstanding issues that will require additional consideration by TC8-01. These include possible image dependencies in the results and possible field-of-view surround effects.

The key accomplishment for the technical committee for the year was gaining consensus on the chroma scaling. Additional analysis and experimentation by Moroney suggested that the chroma magnification for near neutrals is not present in the raw LUTCHI scaling data and may be more a result of fitting the scale without forcing an intercept at the origin. Fairchild has proposed a solution by modifying the chroma equation while Hunt et al. have proposed a new non-linear post adaptation response compression that provides a good fit to the chroma scaling data and has a small intercept. This new non-linear function also addresses a problem of saturation changes with increasing illumination of the adapting field. While a significant revision, the new non-linear function has the advantage of addressing two outstanding issues. Regardless of which revision is used, all members of the technical committee have agreed on minimizing the intercept for the fit for the chroma scale.

In December of 2001 a sub-committee, consisting of Fairchild, Luo, Moroney and Newman, was formed in order to prepare a draft technical report for consideration by the entire committee. This sub-committee will attempt to reach some sort of compromise on the linear chromatic adaptation transform and the non-linear response compression.

Additional documents are available on the TC8-01 web site: <http://www.colour.org/tc8-01/>

## TC 8-02 Colour Difference Evaluation in Images

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**Established:** 1998

**Terms of Reference:**

To study and recommend methods to derive colour differences for images.

**Chairman:** M R Luo  
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**Members:**

Belgium	M Mahy			
Germany	B Hill			
Italy	O Da Pos			
Japan	K Takemura	H Yaguchi		
Spain	J Uroz			
United Kingdom	R Hunt	B Rigg		
United States	P Alessi	M Fairchild	G Field	J Gibson
	D McDowell	M Stokes	S Viggiano	

**Progress report**

- Version 5 of the draft technical report has been distributed to TC members for comment December 2001. It is expected to complete the Version 6 by the end of January 2002. The report is only intended to include all possible methods for evaluating colour differences for colour patches and images.
- The TC will continue to generate test images, to perform psychophysical experiments in different sites and to evaluate the performance of various methods. A work plan will be distributed between members in January.

## TC 8-03 Gamut Mapping

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**Established:** 1998

### Terms of Reference

To study, develop and recommend an optimal solution for cross-device and cross-media image reproduction. This solution will provide a standard procedure to calculate the colour gamut of an image, an imaging system, or its components, and either one algorithm, or a set of algorithms and rules for use in specific applications.

**Established:** 1998

**Chairman:** Jan Morovic  
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### Members:

Belgium	M Mahy			
Germany	P Herzog			
Italy	R Schettini			
Hungary	P Bodrogi			
Japan	N Katoh			
Korea	B-Ho Kang			
United Kingdom	P Green	A Johnson	R Luo	
United States	G Braun	F Ebner	M Fairchild	G Marcu
	John McCann	E Montag	H Motomura	T Newman
	S Viggiano	G Woolfe		

### Progress Report

- A meeting of the TC took place on 8 November 2001 in Scottsdale, AZ with the focus being on finalising the *Guidelines for the Evaluation of Gamut Mapping Algorithms* that the TC has been working on throughout 2001. In addition to discussing remaining issues with the guidelines, the publication of GMA source code and the provision of test images was also discussed.
- In the course of 2001 three revisions of the Guidelines were prepared on the basis of discussions conducted via e-mail. The focus of most of the discussions was whether a single test image or a number of test images should be made obligatory in the Guidelines and changes were also made to the obligatory GMAs that the Guidelines specify.
- A checklist that is to help participants in coordinated research was prepared so as to allow for easy checking of whether a study complies with the Guidelines.
- Fujifilm Electronic Imaging Limited (UK) have made the image that is specified as obligatory in the guidelines available to the TC for its use and distribution to participants of the coordinated research.
- Canon Development Americas (USA) and Sony (Japan) have contributed test images to the TC.
- For more detail see TC web pages: <http://www.colour.org/tc8-03/>

**Future plans**

- Complete Guidelines and publish them as CIE technical report.
- Publish shorter version of guidelines at a conference or in a journal.
- Commence coordinated research on the basis of the Guidelines.

## TC 8-04 Adaptation under Mixed Illumination Conditions

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**Established:** 1998

### Terms of Reference:

To investigate the state of adaptation of the visual system when comparing soft-copy images on self-luminous displays and hard copy images viewed under various ambient lighting conditions.

**Chairman:** Naoya Katoh  
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### Members:

France	E Khoury			
Hungary	P Bodrogi	J Schanda	I Kucsera	K Wenzel
Sweden	M Billger			
United Kingdom	R Luo*	S Sueeprasan*		
United States	P Alessi	D McDowell	M Fairchild*	T Newman

\* Observers

### Working programme and time lines

Original Timeline

- Sep-29-1998: New work proposal at CIE/Division 8 meeting
- Until End 1998: Gather interested members/organizations and form a new TC
- Until End 1999: Survey past relevant works and share a standard method and guideline for cross-examination
- Until End 2001: Perform cross-examinations at different laboratories and compare the results
- Until End 2002: Publish a CIE Technical Report (or Progress Report)
  - Mar. 2002 Prepare First (preliminary) DRAFT
  - Nov. 2001 Prepare Committee DRAFT for review

### Progress Report

In year 2001, Sueeprasan (UK) and Katoh (JP) has performed the experiments according to the TC's experimental guidelines, which was completed in year 2000. The results of two different laboratories showed a fair accordance in mixed adaptation ratio (ie 40-60%). This result is also in accordance with the past results of Katoh, Berns and Choh (US), and Shiraiwa et al. (JP). It was also discussed which CAT (chromatic adaptation transform) matrix should be incorporated into mixed adaptation model. In the mean time, the choice of CAT is now being discussed in the TC8-01. From compatibility point of view, it was agreed that TC8-04 should follow the TC8-01's recommendation, since the difference being discussed are very subtle. With these results, it was agreed that TC should prepare technical report in year 2002.

- TC meeting was held at 09-Nov-2001 at Sunburst Hotel, Scottsdale, AZ, USA

## TC 8-05 Communication of Colour Information

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**Established:** 1999

**Terms of Reference:** (from <http://www.colour.org/tc8-05/>)

To standardise a minimal set of techniques that enable unambiguous and efficient communication of the colour information in images. Two fundamental approaches will be addressed:

1. The association with the image data of additional data that describes the colour space of the image data.
2. The representation of the image data in a standard colour space.

The standard will also define a minimal set of standard colour spaces that addresses a wide range of imaging applications. Whenever possible, existing standard colour spaces will be used in preference to creating new ones.

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### Members:

Belgium	S Liven			
Hungary	K Wenzel			
Japan	N Katoh	H Ikegami		
United Kingdom	L MacDonald	M Pointer	M Wilsher*	
United States	R Balasubramanian		M Gorzynski	J King*
	T Newman	D Rich*	K Spaulding	I Tastl

\* Advisors

### Working Programme and Time Lines

- Draft of evaluation criteria - April 2000
- CIE Experts Symposium on Extended Range Colour Spaces - November 2000
- Sample evaluation - November 2001
- Preliminary evaluations - November 2002
- Draft Technical Report - April 2003

### Progress Report

The last TC meeting was held November 5, 2001 in Scottsdale, Arizona. At this meeting, Kevin Spaulding presented results on evaluating the sRGB, sYCC, e-sRGB, e-sYCC, ROMM RGB and PCS LAB colour spaces against the following colour encoding criteria:

#### I. Color Gamut Metrics

- A. Total Color Gamut Volume
- B. Comparison to target color gamuts
  - real world surface colors

- optimal colors
- legal colors
- CRT colours
- photographic print colors
- photographic transparency colours (not complete)

## II. Quantisation metrics

- A. Quantisation error for single code value change
  - for colours inside all of the colour encodings
  - for colours inside real world surface colour gamut
- B. Quantisation efficiency (#bits needed to achieve certain error level)

## III. Complexity of transform to/from important colour spaces

- A. video preview
- B. PCS XYZ
- C. PCS LAB
- D. SWOP CMYK

His report is available in the Criteria Working Group section of the web page at <http://www.colour.org/tc8-05/documents.html>.

Also prepared at and after the November 2001 meeting were comments on the CDVs for IEC 61966-2-1 A1 (Default RGB Colour Space - sRGB) and IEC 61966-2-2 (Extended RGB Colour Space - scRGB). The comments were submitted to TC 100 as liaison statements from CIE Division 8.

The Proceedings of the CIE Expert Symposium 2000 on Extended Range Colour Spaces, held November 11, 2000 in Scottsdale, Arizona, have been published and distributed as CIEx021:2001, ISBN 3 901 906 10 X..

The next face-to-face meeting of CIE TC8-05 is planned for November 2002, around the time of the IS&T/SID Color Imaging Conference in Scottsdale, Arizona.

## TC 8-06 Image Technology Vocabulary

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**Established:** 2000

### Terms of Reference:

To liaise with other Division 8 Technical Committees and collate definitions of terms associated with image technology.

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### Members:

France	S Laget			
Germany	K Richter			
Japan	H Ikeda	H Yaguchi		
United Kingdom	A Johnson	L MacDonald	J Morovic	M Pointer
United States	R Buckley	B Donovan	E Carter	J Holm
	D McDowell	T Newman	K Spaulding	M Stokes

### Working Programme and Time Lines

Up to November 2000, work was carried out by correspondence. The Chairman has submitted parts of several terminology documents to members to consider what should be included in a technical report. At the TC 8-06 meeting in Scottsdale on 11-Nov-2000 it was decided that the TC should collect terms and definitions and place them in a database.

Members and Liaison Persons (from ISO TCs) will send recommendations, The chairman will consolidate the material. The time-scale is:

- Input to the Chairman: 2000-12-15
- Circulation of database: 2001-01-31
- Feed-back to the Chairman: 2001-03-15
- 2nd draft: 2001-06-30
- Translation of terms, feed-back: 2001-09-30
- 3rd draft: 2001-12-15

### Progress Report

At the last meeting in Scottsdale, Arizona, in November 2000, several further people announced interest in the work of this TC.

**Progress Report December 2001**

Unfortunately up to ISO TC 42 no further input has been received. This material has been distributed to members, but without feedback. The Chair was unable to attend the 2001 Division 8 meeting and therefore asked the Div. Secretary to request that all Technical Committee Chairs submit relevant terms and definitions.

The construction of a database has been started and will be circulated to the Technical Committee members in 2001.

## **R8-01: Grading of Color Measurement Equipment**

**Reporter:** Dr. Yoshi Ohno  
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## **R8-03: Potential CIE and IEC/TC100/PT61966 interactions**

### **Terms of Reference:**

To produce a report on how CIE Division 8 should interact with IEC TC100 PT61966

**Reporter:** Hiroaki S. IKEDA  
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## **R8-04: The effect of fluorescence on colour characterization of image reproduction media**

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