

# CIE Division 8

## Technical Committee 8-03: Gamut Mapping

*Minutes of 26/3/99 Meeting in Derby*

*Compiled by Suki Atwal and Jan Morovic*

### 1 Attendees

Attendees are listed in alphabetical order and TC 8–03 members are marked with a \*.

Suki Atwal (Secretary)	Tim Kohler
Rob Buckley	Ronnier Luo *
Oswaldo Da Pos	David McDowell
Dirk De Baer	Jan Morovic (TC Chair) *
Fritz Ebner *	Todd Newman (Division 8 Chair) *
Phil Green	Michael Pointer
Tony Johnson *	Craig Revie
Naoya Katoh *	Pei-Li Sun
Jim King	Mike Wilsher

### 2 Publication of Literature Survey Report

The first point of discussion related to the publication of the *Survey of Gamut Mapping* carried out for the purposes of this TC. Mike Pointer suggested the CIE Collection or publication as a CIE Report as possibilities within the CIE's context. It was then argued by Tony Johnson that the survey should be made widely available (e.g. as a journal paper) and that this would not be the case if it were a CIE publication. Tim Kohler suggested the publication of sections 1–4 and section 6 as a *Color Research and Application* paper and to make section 5 (which contains reviews of the individual papers) available on the internet (e.g. on the TC's web site).

The point of contributing to an imaging vocabulary was also raised.

### 3 Terms of Reference

It was suggested by Fritz Ebner that the Terms of Reference of this TC should be read, so as to have a common understanding of the aims of this TC. The Terms of Reference are the following:

*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.*

The reading of the Terms of Reference was then followed by a thorough discussion of the reproduction intent to be pursued by the gamut mapping solution mentioned in the Terms of Reference.

#### 3.1 Aim of Gamut Mapping to be Recommended

The debate centred around the meaning of the term “accurate reproduction”, whereby there were two main interpretations – one, supported primarily by Tony Johnson,

claimed that the accuracy of reproduction is measured using colour difference (i.e. some  $\Delta E$  metric) and the other, supported mainly by Ján Morovic and Ronnier Luo, claimed that the accuracy of reproduction can at present only be established by psychophysical means.

Tim Kohler posed the question of where the line between colour appearance and gamut mapping is to be drawn so as to separate the effects of one from the other.

The discussion then turned on the definition of accurate reproduction given in section 1.1 of the *Survey of Gamut Mapping*: “The **accuracy** of a reproduction describes the degree of similarity between the original image and a reproduction of it.” The question of what psychophysical methods can be used for determining this “similarity” was raised and the pair comparison method was discussed. Dirk De Baer noted that similarity can be seen to depend on the reproduction intent itself.

Naoya Katoh stated that since we don’t have an absolute image difference metric, we have to use psychophysics for establishing image difference. Rob Buckley then made a distinction between objective measures (e.g.  $\Delta E$ ) and subjective measures (e.g. psychophysical methods) and warned against confusing uncertainties of a metric with uncertainties about what one is trying to do.

Tim Kohler made a point about the possible need of determining the “intent” of given images and again suggested that perceptual difference is not the same as  $\Delta E$ . Michael Pointer defined accuracy as difference from the original in terms of colour appearance and Jim King pointed out that preserving an image’s appearance also means that image appearance should not be improved. Tony Johnson made a distinction between metric accuracy and subjective accuracy.

Jim King also provided this written summary after the TC meeting: “To determine the best gamut mapping algorithm within today’s state of the art and within the abilities of this committee that preserve subjective similarity as judged by psychophysical experiments. Preserving similarity, as used here, does not include improvements to images mapped with this algorithm that go beyond improvements inherent in the gamut change. That is, basic flaws should be preserved as similar as well as the subjective quality. The gamut mapping algorithm is not required to preserve pixel by pixel colours by any measure unless, of course, that promotes subjective similarity overall.”

The terms *subjective accuracy* or *psychophysical similarity* seemed to be agreed on as describing the intent to be pursued by the gamut mapping solution to be recommended by this committee, whereby this intent is one which aims at reproducing a given colour image in a way where the reproduction is as close to the original as possible, this similarity is determined psychophysically and the process has no image enhancing aims.

## 4 Guidelines

The second part of the meeting tried start the process of arriving at experimental guidelines for evaluating gamut mapping algorithms, which is the second stage of this TC’s work. The following sections are the areas which were suggested as parts of the guidelines and TC members present at the meeting already agreed to prepare some of them. The process of preparing the guidelines will be one where individual sections are prepared by a small number of TC members, these sections will then be collated and distributed to the entire TC for comments and approval.

It was also agreed that the guidelines should mostly be about how to report what is used in a given experiment rather than about prescribing what is to be done. In most

cases there will be some recommended options (e.g. CIECAM97s, some GMAs, etc.) and participants in this coordinated research will be given the freedom to explore alternatives. A deadline of June 1999 was suggested for the first drafts of the individual parts of the guidelines.

Each of the following sections is a suggested part of the guidelines and will consist of two parts – first, a list of points agreed on at the end of the TC meeting and second, detailed comments made by individual attendees.

#### **4.1 Test Images (Tony Johnson)**

- on all media types
- CRT computer generated
- Small number of recommended images
- Same size (angular subtense, physical size)
- Image characteristics to be reported

Tony Johnson pointed out that it is a big problem to get someone to produce the non-digital images needed for the gamut mapping experiments. David McDowell suggested that all three major film manufacturers (Agfa, Fuji, Kodak) should share this task. Test images should also be accompanied with characterisation data for the medium on which the images are presented.

#### **4.2 Media**

- CRT, print, transparency – any combination of source and destination
- Participants to provide measured data for IT8 targets (basic set from IT8/7.3)
- large and small differences
- simulation

Naoya Katoh suggested that the CRT to hard-copy scenario should be encouraged as it is the case 90% of the time. The reproduction from transparency to hard-copy is also important and viewing conditions need to be specified.

Giving room for simulated media differences and real media differences was also considered to be important.

#### **4.3 Viewing Conditions (Tony Johnson)**

- same white point
- define number of options (surround, etc.)
- define some, require the reporting of others

#### **4.4 Measurement**

- ISO 13655

#### **4.5 GMAs (Jan Morovic)**

- recommend a small number of GMAs to be tested
- provide C source code

#### **4.6 Gamut Boundary (Jan Morovic & Tim Kohler ICC)**

- measurement procedure

- media & images
- modelling
- cooperate with ICC

#### **4.7 Colour Space**

- CIECAM97s2 (ask TC8-01 to give source code of 97s)
- others

Ronnier Luo also pointed out that TC8-02 is testing a CIECAM97s based colour difference metric and that a modification of CIECAM97s has been developed to overcome some of the models difficulties which can result in negative lightness values under some conditions. A PDF file of the paper will be made available on the TC's web-site.

#### **4.8 Experimental Method (Fritz Ebner)**

- reporting results

It was suggested that TC1-27 and TC1-34 methodology for reporting results should be looked at for reference.

### **5 Other**

Todd Newman raised the question of communication between TC members, whereby the suggested options were a mailing-list and news groups. There seemed to be a preference for mailing lists and there was some discussion about whether the mailing list should be public or private to the TC. The possibility of two mailing lists was also made. Finally, it was suggested that a mailing list be set up and that an archive feature should also be used.