

**CIE Division 8 TC8-01**  
**Colour Appearance Models for Colour Management Applications**  
**Fall 1998 Report**  
*Gary Dispoto - TC Chair*

**TC8-01 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.

**TC8-01 Membership**

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## **Plan of Work/Timetable**

This is a slightly modified version of the timetable that was presented at the Division 8 Organizational Meeting in Baltimore in September 1998. Since the TC is just beginning to start its work and many members are providing input for the first time, I expect this will change somewhat in the upcoming quarter.

### Fall 1999:

Determine initial TC Membership. Develop initial plan of work.

### Winter 1999:

Discuss work to be done among TC members. Determine roles for each member. Assess initial colour and engineering requirements for a colour appearance model to be used in colour management applications. Requirements will be identified in the areas of:

- computational efficiency
- visual phenomena accounted for
- viewing condition inputs

### Winter/Spring 1999:

Investigate and assess mathematical models that meet colour and engineering requirements. Leverage heavily off the work of TC 1-34, which developed CIECAM97s. Pursue refinements of CIECAM97s that model the colour appearance phenomena that are required, while meeting implementation requirements.

### Summer/Fall/Winter 1999:

Issue short activity report, with an emphasis on any interim recommendations that can be made. Development and testing cycle for model.

- Complete initial model development.
- Complete initial development of guidelines for using the model in particular applications and setting the viewing condition inputs.
- Perform psychophysical testing of model performance, using a variety of imaging technologies
- Finalize model and input parameter guidelines.

### Spring 2000:

Issue final CIE Technical Report.

## **Fall 1999 Progress**

### Determined initial TC membership.

The membership is a good balance of experts in colour science and engineering from academia and industry. This is particularly important for a technical committee such as TC8-01, for which the goal is to provide industrial engineers with a useful, yet practical model of colour appearance.

### Identified primary issues.

The TC began a discussion of the major issues that need to be resolved, a ranking of the issues, and, in some cases, potential solutions. Technical and engineering issues identified thus far are:

#### 1) Floating $J_{min}$ :

This issue also manifests itself as the reverse model yielding negative tristimulus values. The minimum  $J$  that can be obtained from the forward model is not equal to zero and is not fixed. It varies based on the surround parameter, ranging from about 2-6 for the various surround categorizations (excluding cut-sheet, for which  $J_{min}$  actually goes to about 10). If the reverse

model operates on a J that is lower than Jmin for the surround setting being used, the tristimulus values calculated may be negative.

#### 2) Categorical Surround:

Three categories for surround seems rather a coarse categorization. Since we will be developing measurement guidelines for setting the input parameters, it may be better to have surround be a continuous input, based on something that could be measured.

#### 3) Gamut Size Issue:

We have noticed that if we take a the tristimulus values that define the gamut boundary for sRGB and tranform them to CIECAM97s Jhc using the dark, dim, and average surround settings, the gamut size ordering in Jhc space is dim, average, dark. Both Drs. Hunt and Luo have mentioned to us that this can be "fixed" by proper changing the recommended setting of Nc for the various surround categorizations.

#### 4) Invertability:

I've been told that if you run CIEXYZ values through a forward-reverse CIECAM97s pair using the same VC (viewing condition) settings for both forward and reverse model, that the difference between the input and output XYZs can be "as much a 7%." This may or may not be a real problem, but we ought to get it on the list of things to look at.

#### 5) Cartesian representation:

Develop a simple, CIE recommendation for representing Lhc using a cartesian coordinates, as well as official variable names for those coordinates. At HP, we've been using:

$$ac97 = c * \cos(h)$$

$$bc97 = c * \sin(h)$$

#### 6) Complexity:

Any way to reduce?

#### 7) Chroma Expansion:

The model seems to expand near-neutral chroma, relative to other uniform colour spaces such as CIELAB, Munsell, and OSA.

#### 8) Viewing Condition Parameter Guidelines:

This may be the most important aspect of what our TC does. The CIE has provided a very powerful new tool to engineers doing colour reproduction/management/processing, however the tool does have quite a few more "knobs" than what they are used to (CIELAB). There is plenty of opportunity for CIECAM97s to be misused by those doing implementation work. CIECAM97s then runs the risk of being branded either "too complicated" or "broken" (due to misuse). Clear, complete defaults and guidelines for using the model, endorsed by the CIE itself, will go a long way toward encouraging acceptance and use of the model.

### **Plan for Winter 1999**

- Continue discussion and ranking of CIECAM97s issues.
- Determine appropriate work for each member (who can do what).
- Begin development of solutions for items 1-7, which all potentially involve changes to the model itself. Some of these issues should be resolvable in the coming quarter, while others will be ongoing.
- Setup CIECAM image processing testbed at HP Labs, to simulate the use of CIECAM in colour management systems.
- Begin processing images from various sources and to various destinations, toward end of developing viewing condition input defaults and guidelines.
- Assess need for psychophysical testing and begin development of a plan for such testing.