# Inter-Society Color Council *News*

Issue 457 May-Jun 2012

## In Memoriam:
## *Marge Stanish, 1947 – 2012*

*Dignified. Graceful. And possessing a howling laugh that said, "You just touched my soul!"*

The industrial color technology community lost a wonderful colleague, Marge Stanish, who passed away on February 3, 2012. Marge spent over 30 years in a variety of roles on both sides of the technology, as both a system user and a color science educator. While she enjoyed an extended tenure with Applied Color Systems, her career was bookended by positions in manufacturing settings, placing her at the intersection of color science theory and practice. This grounding in production environments enhanced her ability to successfully implement color control systems in a variety of settings, troubleshoot their performance and design training programs and materials to support a wide range of color control system operators. *(continued on page 3)*

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## Annual Meeting 2012
## POSTPONED
## October 16-17, Manchester, NH

To maximize participation and the quality of the program, your Board of Directors made the difficult decision to postpone the annual meeting until this fall. The venue will remain the same: the Radisson Hotel Manchester Downtown in Manchester NH. One effect is that the Call for Papers can now be extended. We have a good variety of talks already, and we look forward to collecting more for the fall meeting. Please see the Call for Papers posted on the ISCC website. The plan is for a day of traditional annual meeting with presentations from our three interest groups as well as an education session. On day two we are excited to include sessions on Green Color, meaning the use of environmentally-friendly processes in the creation of color.

Our requirements for submission are flexible; generally abstracts are expected to be 2-5 pages. If you have specific questions regarding your paper, please contact one of the program committee:

- IG 1: Basic and Applied Color Research, contact Ms. Ann Laidlaw, `ALaidlaw@XRite.com`
- IG2: Industrial Applications, contact Mr. James Roberts, `jim.roberts@altanachemie.com`
- IG3: Art, Design and Psychology, contact Dr. David Wyble, `wyble@cis.rit.edu`
- Educational Session, contact Dr. David Wyble
- Environmental color session, contact Dr Romesh Kumar, `Romesh.Kumar@clariant.com`

The General Co-chairs are Dr. Art Springsteen (`arts@aviantechnologies.com`) and Mr. John Conant (`jconant@aerodyne.com`). Please contact Art Springsteen if you have questions regarding this meeting. More travel information will be provided closer to the meeting date.

## CORM Annual Meeting

The 2012 Annual Meeting of the Council for Optical Radiation Measurements will be held in Ottawa Canada on May 30 – June 1. They have assembled an excellent program of technical presentations, tours of NRC laboratories, and an evening banquet including the Franc Grum Memorial Lecture. This year, the Grum Lecture is titled "Spectral Infrared Radiation Measurement from Space" and will be given by Dr. Henry Buijs. Complete details for the conference can be found here: `www.cormusa.org/CORM2012.html`

## 12th AIC Congress<br>The Sage Gateway, July 8-12, 2013

The AIC Congress is held every four years and is the only international color conference that promotes all facets of color.

The main theme of the 2013 conference will be *Bringing Colour to Life*, in the practical sense of color production and reproduction, in the sense of color in nature, and the ways in which color can be used sustainably now and in the future.

For the latest details and information, visit `www.aic2013.org` or email `info@aic2013.org`.

## Chromatic Adaptation for Display Profiles

*Posted on April 22, 2012 by Parker Plaisted*

When I was working on improvements to the OptiCAL software in 1998, one of the challenges was the selection of the chromatic adaptation algorithm. At the time, the International Color Consortium (ICC) did not specify a chromatic adaptation algorithm, so each software developer could choose any method for chromatic adaptation.

Let me back up and give you a little more context for this issue. The ICC had specified CIE D50 for the white point of the Profile Connection Space (PCS). Therefore, all the color coding in the PCS had to have a white point of D50. That worked well for output profiles (e.g., printer profiles), but it created an extra step in the creation of display profiles (e.g., monitor profiles) and RGB color-space profiles when the native white point was not D50. That extra step was the application of a chromatic adaptation transform.

*Read the rest of this entry at:*
`www.color-image.com`

*Marge Stanish Memoriam*
*continued from Page 1*

In the late 1970's, Marge began her career in color technology as lab technician in the paint lab of Mobil Chemical in Cleveland, OH. From 1981 to 1993, Marge worked for Applied Color Systems. She began as an Application Specialist supporting users of ACS color control systems in a variety of pigment-based applications. In the late 1980's, ACS made a significant commitment to user education creating an Educational Services group, and undertaking the production of a color theory video series in partnership with Ralph Stanziola. Marge was tapped as the executive producer of this multi-year project. Innately talented in bringing people together, she facilitated a collegial relationship between the video production professionals and the color science subject matter experts assembled for this venture. *Industrial Color Technology: Theory and Applications* was the product of this successful collaboration. A comprehensive survey of fundamental color science principles and practical application examples from a variety of industries, the five-part video series remains a foundational reference work for any user of industrial color technology. Following the completion of the project, Marge finished her tenure with ACS/Datacolor as the Product Manager for their newly created retail color matching product, Paintmaker, helping to establish it as a standard tool for retail color design.

In 1996 Marge was hired as Manager, Instrumental Color Technology by Penn Color, a Doylestown PA based manufacturer of color concentrates, dispersions and specialty coatings. This opportunity allowed Marge to expand her knowledge of the operation and maintenance of a variety of instruments and software packages to include Byk-Gardner, Minolta and X-Rite color measuring/color matching systems, as well as appearance instrumentation including haze and gloss meters. In addition to providing training and applications support to Penn Color employees and customers on this array of equipment, Marge was also called on by the management team to anticipate the technical demands of the marketplace going forward, offering thoughtful recommendations regarding the color instrumentation/software packages that would best meet those needs. At the April, 2012 NPE show in Orlando, Penn Color introduced their newest technology, a color measuring device the "Chroma Sort M," named after Marge—a rare gesture that speaks to their appreciation of her technical contributions to the organization and perhaps, more importantly, their esteem for her as a member of the Penn Color family.

*Dignified*. Without fail, Marge treated everyone she encountered with the utmost respect, while maintaining her professional and personal integrity. *Graceful*. Marge had a quiet elegance about her—she was the quintessential professional. *And that laugh!* Everyone who has shared recollections about Marge since her passing has remarked on her extraordinary laugh. It was a pleasure to call Marge my colleague. It was a privilege to call her my dear friend. Those of us fortunate enough to have known her personally are mourning her loss. We can all find comfort in the recognition that she left us better than she found us—we are better color technologists and better human beings for having crossed paths with her.

Kim Galloway
*Morrisville, PA*

## INVITATION TO ISCC VIRTUAL LIBRARY

While the rest of the publishing world charges admission for every reprint and standard, please be aware that the ISCC has opened the door for **free** admission to a virtual library of color history. Visit `www.iscc.org`, and click on the bottom-left gray rectangle, Online Resources. There you will find gems such as the following: Isaac H. Godlove's full-length book, *The Earliest People and their Colors*; an archive of Historical Translations to English (including Lambert's color pyramid, König and Dieterici's article on fundamental sensations, Ostwald's researches in color science, a treatise on pastel painting, Luther's work on color-stimulus metrics, Runge's color sphere, and Schrödinger's theory of colors of greatest lightness). Rolf Kuehni was instrumental in translating and/or editing most of the works in this site, and you'll find a number of other names as well. Incidentally, among the Online Resources, you can also find an archive of Hue Angles columns and Bob Chung's *Demystifying Color*. In this virtual library (which is sure to grow), the ISCC spans the centuries. Come visit!

*Editor's Note: The ISCC is very grateful to Mike Brill and Rolf Kuehni for their dedication in making these important historic texts available to us all.*

# HUE ANGLES

(Send contributions to mbrill@datacolor.com )

## A Horsehead Nebula of a Different Color

*Having recently undertaken to summarize some astrophysical topics for color scientists, I am confronting another language barrier between neighboring fields.*

About ten years ago, astrophysicists Karl Glazebrook and Ivan Baldry introduced the world to "the color of the cosmos" — an average color of all the stars, corrected for red shift. I reviewed that work as it evolved in interaction with ISCC feedback [ISCC News # 397, May/June 2002]. The astrophysicists' first answer, "turquoise," changed quite a bit as the data conversion to color was refined. The final accepted color, obtained via a color-appearance model, was declared to be "beige" or "cosmic latté." Some of us dissented: The answer "salmon" was consistent with the correct chromaticity, and the answer "black" could not be ruled out because, relative to a screen white, the average night sky is, after all, black.

The dialogue about cosmic color was instructive to everyone, partly because it revealed a difference of language and thinking between astrophysics and color science. Within the ISCC community, we already know some peculiarities of language; e.g., colors that are warm to artists have low color temperatures for scientists; and contrast in the display industry is defined to be greater than 1, whereas contrast in the paint industry is defined to be less than 1. These are familiar enough. But since we of the ISCC don't often talk with astrophysicists, we may be unaware of some language stumbling blocks between these communities.

One example is "luminosity," which to us means integrating a spectral power distribution weighted by a bell-shaped function that peaks at 555 nm. However, in astrophysics, "luminosity" means the power integrated over the whole electromagnetic spectrum. Sometimes, astrophysicists prefix their "luminosity" with "bolometric," and that removes the confusion. However, we still should watch out, as such niceties as a prefix are often lost in a technical discussion.

Another term, "brown dwarf," refers to an infrared-radiating object that has too little mass to burn as a star (i.e., to sustain nuclear fusion). To color scientists, it is an oxymoron to call a self-luminous object brown. Some astrophysicists are aware of this problem. For example, Kenneth Brecher of Boston University, in a talk called "How Now, Brown Dwarfs," referred to Joseph Silk's objection that "brown is not a color." (Well, actually brown *is* a color, but Silk had a point.) Brecher concluded that an isolated brown dwarf would look similar to a neon gas-discharge light.

Still another astrophysical term that will bemuse color scientists is the "green valley" of a galaxy color-magnitude diagram. A color-magnitude diagram is a plot of galaxy color (actually difference between logarithms of light received through a blue and a violet filter) and luminosity (the bolometric kind, if you please). At the top of the diagram is the "red sequence" of galaxies, at the bottom is the "blue cloud" of galaxies, and in between is the "green valley". In one sense the term should not confuse, because the "green valley" is a place with a conspicuous lack of galaxies, that lack being because there are no green black-body radiators. However, to name a thing for an absent attribute is a bit of a brain-boggler.

The galaxy color-magnitude diagram is an example of the use of color versus brightness to sleuth out the evolution of distant astronomical objects. An earlier such diagram, designed for individual stars rather than galaxies, is the Hertzsprung-Russell diagram, which has existed in various forms for about 100 years. The sleuthing process is quite intricate, given our limited perspective on the universe, and I am trying to learn more about it. For readers who want a reasonable introduction, I recommend the Wikipedia articles on the Hertzsprung-Russell diagram and the galaxy color-magnitude diagram.

As a final example of a word whose meaning becomes less certain in the astrophysical arena, consider how to render a "true" color. Together with such familiar issues as camera-to-tristimulus transformation, one wonders whether to correct the red shift of a distant receding object. If we do, then the object has the color we would have seen in its vicinity long ago; if not, then it's the color we see now from afar. Fortunately that issue doesn't affect near objects such as the Horsehead Nebula (a mere 1500 light-years away). Even so, Internet search reveals a variety of colors for the Horsehead Nebula. The colors may not be "true," but are surely "different" — hence the title of this essay.

Michael H. Brill, *Datacolor*

## Color Research and Application
## IN THIS ISSUE, May 2012

Color Rendering Index has been a hotly debated topic in the International Commission on Illumination (CIE) for the past several years. The color rendering index (CRI) is a metric used to evaluate how accurately artificial light sources reproduce the colors of objects when compared to natural light sources. It was first developed in the middle of the 20th century by the CIE, but has been under scrutiny off and on for at least 20 years. With the advent of light emitting diodes (LEDs) the discussions have become more intense. In this issue Cheng Li, M. Ronnier Luo, and Changjun Li propose a new CRI metric. In "The CRI-CAM02UCS Colour Rendering Index" they describe the new index which has an improved chromatic adaptation transform and uses the CIE color appearance space identified as CIECAM02.

For our next two articles we will look at more black and white issues. First, have you noticed that in recent years white paper looks cleaner and brighter? That is because optical brighteners are added to most paper (and also to laundry detergents for brighter white clothes). Earlier the yellow tinge of paper or cloth was hidden by the addition of a small amount of blue dye (called bluing agents), but more recently rather than making paper appear more neutral by lowering the yellow reflectance, the blue part of the spectrum is boosted by an fluorescent whitening agent which absorbs radiation in the ultraviolet region and emits light in the blue region, thus making paper appear brighter and whiter. However, the addition of a fluorescence component increases the complexity of the color measurements on these materials. In our next article, "Practical Method for Measuring Printed Colors on FWA-treated Paper" Kenji Imura describes a new, practical technique for the approximate measurement of the colorimetric properties of an object that has been treated with a fluorescent whitening agent (FWA).

Just as fluorescent whites create measurement issues, very dark, i.e. low reflecting materials provide measurement challenges. And while whites have been widely studied, blacks have not been studied much, possibly because of the measurement challenges of very low signal responses. Razieh Jafari, Seyed Hossein Amirshahi, and Seyed Abdolkarim Hosseini have taken up the challenge of the "Spectral Analysis of Blacks." They examined three different spaces: reflectance space, the inverse of reflectance, and the Kubelka-Munk function of reflectance. While black ideally is neutral, in reality black materials are very low brightness, but can be made up of different hues. They study the dimensional properties of sets of black and deep gray samples composed of black papers and fabrics by extracting the main directions of such data and trying to reconstruct the spectral properties of data using principal component analysis.

From blacks we move on to another measurement challenge. Eric Kirchner and Werner Cramer write about "Making sense of measurement geometries for multi-angle spectrophotometers." The first metallic pigments caused color changes mainly in lightness as the angle at which they were viewed changed. Measurement techniques that considered the distance from the specular beam were proposed. Pigments with increasingly complex color effects have been introduced and used in the automotive industry and other areas. With the newer pigments, the effects are not only changes in lightness, but also definite hue shifts. Subsequent research has resulted in instrumentation that measures at multiple geometries both with different illumination and viewing angles. In their article, Kirchner and Cramer not only discuss the applicability of geometric concepts of aspecular angles, cis- and trans-geometries, interference lines and aspecular lines from the specimen plane, but they also introduce the new concept of flake-based parameters.

Coatings and textiles with distinctive properties in the ultraviolet, visible, and near infrared regions (NIR) of the spectrum have been developed for various applications. They may be trying to mimic natural objects in not only color, but pattern, texture, and gloss. In "The Effect of Nano and Micro $TiO_2$ Particles on Reflective Behavior of Printed Cotton/Nylon Fabrics in Vis/NIR Regions" Sayed Majid Mortazavi, Mohammad Khajeh Mehrizi, Shadpour Mallakpour, and Seyed Mansour Bidoki report on their studies investigating the effect on the reflectance of printed patterns of adding titanium dioxide particles with various sizes to the printing paste formulations. The particular colors studied were colors in desert shades including brown, olive green and khaki. Overall, titanium dioxide micro and nanoparticles were proven to be critical constituent pigments playing a significant role in NIR reflectance behavior of printed fabrics for

*continued on next page*

*"In This Issue" continued from previous page*

nanoparticles NIR tuning effect.

From properties of coatings and textiles, we next look at the "Goniochromatic properties of human tooth dentin." Yong-Keun Lee, Guang-Feng Zhao, Bin Yu, and Huan Lu report on their study of how the color appearance of a tooth changes when measured at various viewing angles. They also determined the influence of the microscopic structural non-uniformity of dentin surface on the goniochromatic properties of teeth. It is hoped that biomedical dental restorative materials simulating these properties will be developed.

We move to the field of textiles for our next article. While some textiles are woven then dyed or printed, others get their color by using colored fibers. Different colored fibers may be combined in certain proportions to obtain special aesthetic visual effects, such as a mottled appearance. This type of textile coloring requires special techniques to match the standard color. Yuzheng Lu, Weidong Gao, Jihong Liu have been working on this problem. In "Color separation for colored fiber blends based on the fuzzy C-means cluster" they describe the fuzzy c-means cluster (FCM) method, which is used in their procedure to make the color clustering analysis. The proportion of each color should be equal to that of the pixels' color attached to each cluster centers. The hue, saturation, value (HSV) color space was found to be the best for this analysis.

They propose a computer aided color matching based on the fuzzy C-means (FCM) clustering method in HSV color space. The recipe for the final product can be obtained through the statistical method based on the analysis on a large number of blends images.

For our final article we dabble in to the realm of synesthesia. Synesthesia, simply taken, is when the stimulation of one sensory or cognitive pathway leads to automatic, involuntary experiences in a second sensory or cognitive pathway. It could be the sound of music causing associations of color, or in the case of our final article color and aromas. In "Harmonious Color Model with Fragrances" Kumiko Miura and Miho Saito report on two experiments, which allowed them to produce a predictive model for to develop a harmonious color model for fragrance. A unique and original feature of their research is that they adopted the concept of harmony as they examined color and olfactory impressions to bring together these two different types of sensations. From their work it is hoped that people can predict and select harmonious combinations of color and fragrance for use in everyday life or in the fields of marketing, medicine, and other areas.

We close this issue with two book reviews and a call for sharing data. S. Bianco and Raymondo Schettini review the book, *Computational Photography* (edited by Rastislav Lukac). Max Derhak tells us about Klein's *Industrial Color Physics.* Dr. Li-Chen Ou, the Chair of the CIE Technical Committee 1-86 on 'Models of color emotion and harmony' requests help from the color community. The technical committee is looking for existing experimental datasets on color emotion, color image, color meaning, color association, color-emotion association and color harmony that they can use for developing their models.

Ellen Carter
*Editor, Color Research and Application*

**Calendar**

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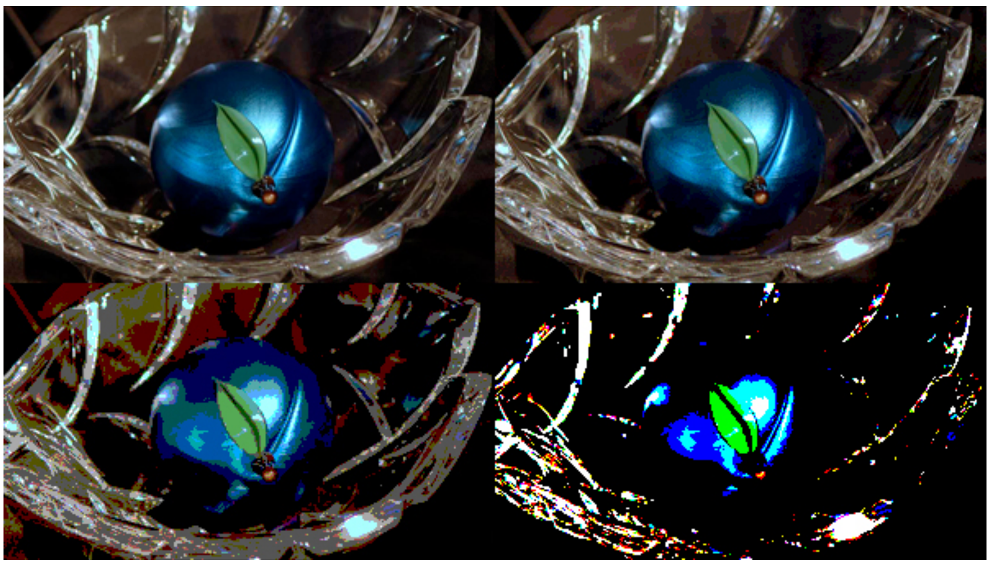
|---|---|
| **May 6 – 9** | **IS&T Color in Graphics, Imaging, and Vision,** Amsterdam, the Netherlands www.imaging.org/ist/conferences/cgiv/ |
| **May 29-Jun 1** | **CORM 2012 Annual Technical Conference**, Ottawa, Ontario Canada, www.cormusa.org |
| **Jun 3 – 8** | **SID Display Week**, Boston MA. www.sid.org/ConferencesExhibits.aspx |
| **Jun 5 – 7** | **Munsell Color Science Lab Industrial Short Courses**, Rochester, NY. www.cis.rit.edu/mcsl/SSC |
| **Jun 13 – 14** | **ASTM E12**, ASTM Headquarters, West Conshohocken, PA. www.astm.org |
| **Sep 22 – 25** | **AIC Interim Meeting**, Taipei, Taiwan. www.aic2012.org |
| **Sep 26 – 27** | **CIE Division 1: Color and Appearance**, Taipei, Taiwan. www.cie.co.at |
| **Sep 28 – 29** | **SCAD Meeting 2012**, W Chicago City Center Hotel, Chicago IL www.scadent.org |
| **Oct 16-17** | **ISCC Annual Meeting**, Manchester NH (see page 1) |
| **Jun 13-1, 2013** | **ASTM E12**, Hyatt Regency Riverfront, Jacksonville, FL. www.astm.org |

*[The editor repeats his plea, nay,* ***beg*** *for a Calendar Editor to handle this on a regular basis. An outdated calendar is far worse than none, and soon a difficult decision may have to be made.]*

# Metameric Blacks: A Color Curious Column

Ever wonder ... ""can my computer really display 'millions' of colors?""

Not really. In theory most computers can produce about 16.777 million different color combinations for display on the monitor. This number comes from the fact that each of the red, green, and blue primary channels used to control the computer display is controlled with an 8-bit number. An 8-bit number can have 256 possible levels ranging from 0 to 255. Zero is used to represent the color channel being fully turned off while 255 represents fully turned on. Thus a black color is encoded with 0,0,0 for R,G,B while white is encoded with 255,255,255. Since there are 256 possible levels of red, green, and blue and each is independent of the other, then there are 256 x 256 x 256 (about 16.7 million) different color combinations that the computer can theoretically display and that is where the term "millions of colors" came from.



However, theory and practice are different. First of all, no computer displays have 16.777 million pixels, so it is not possible to display all of those color combinations at the same time. Secondly, many of those color code combinations do not produce distinct colors. For example many of the color codes that are close to zero would all look black to us, so it is not correct to suggest that they are all separate colors when we cannot possibly tell them apart. (And remember, color is a perception.)

Realistically, for most images and typical viewing conditions, an encoding with 5- or 6-bits per channel is indistinguishable from one with 8-bits per channel. That means that an image with around 33 thousand color combinations is usually indistinguishable from one with all 16.777 million possible color combinations. Therefore it is more realistic to say that the computer can really display only thousands of colors, not millions.

These images illustrate a color photograph quantized (or encoded) with different numbers of levels for each of the red, green, and blue primary channels. The upper left panel is encoded with 24 bits, or 8-bits each of red, green, and blue. This produces 256 levels of R, G, and B for a total of over 16.7 million possible color combinations. The upper-right panel is encoded with 12 bits (4 bits, or 16 levels for each RGB channel) for a total of 4096 possible color combinations. The lower-left panel is encoded with 6 bits (2 bits, or 4 levels for each RGB channel) for a total of 64 possible color combinations. Finally, the lower-right panel is encoded with 3 bits (1 bit, or 2 levels for each RGB channel) for a total of 8 possible color combinations. Incidentally, this is an image of a glass plum with a blue aurene finish. Blue aurene is an application of gold on the surface of the glass (or crystal) to produce an iridescent blue finish. This finish was made famous by Steuben Glass in the early 1900s.

Content of this column is derived from *The Color Curiosity Shop*, an interactive website allowing curious students from pre-school to grad-school to explore color and perhaps become interested in pursuing a science education along the way. Please send any comments or suggestions on either the column or the webpage to me at <*mdf@cis.rit.edu*> or use the feedback form at <*whyiscolor.org*>.

Mark D. Fairchild
*Rochester Institute of Technology*

## ISCC Sustaining Members

*Sustaining Members of the ISCC are organizations who support the mission and goals of the ISCC through financial or other support. With our Member Bodies, Sustaining Members also provide a critical connection to the color community. If you feel your company or organization should support the ISCC in this way, please contact the office for more information about member benefits.*

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|---|---|---|
| Avian Technologies | www.aviantechnologies.com | 603-526-2420 |
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| IsoColor Inc. | www.isocolor.com | 201-935-4494 |
| Chester F. Carlson Center for Imaging Science | www.cis.rit.edu | 585-475-5944 |
| X-Rite Incorporated | www.xrite.com | 616-803-2113 |

***Thank You!***

**ISCC News Issue #457 May/Jun 2012**

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## ISCC Member Bodies

*At its foundation, the ISCC is composed of many related societies. These societies, our Member Bodies, help the ISCC through small annual dues as well as maintaining a relationship with each organization's individual members. We frequently hold joint meetings to further the technical cross-pollination between the organizations.*

*If you belong to one of our member body organizations, we encourage you to work with ISCC and your society to further the connection. Contacting the ISCC President is a good place to start. If your organization is not on this list and you think it should be, the ISCC office can provide you with details about membership.*
*Or use our new online application: www.iscc.org /applicationForm.php*

American Association of Textile Chemists and Colorists (AATCC)
American Society for Testing and Materials International (ASTM)
American Society for Photogrammetry & Remote Sensing (ASPRS)
The Color Association of the United States, Inc. (CAUS)
Color Marketing Group (CMG)
Color Pigments Manufacturing Association (CPMA)
Council on Optical Radiation Measurements (CORM)
Detroit Colour Council (DCC)
Gemological Institute of America (GIA)
Illumination Engineering Society of North America (IESNA)
International Color Consortium (ICC)
National Association of Printing Ink Manufacturers (NAPIM)
Optical Society of America (OSA)
The Society for Color and Appearance in Dentistry (SCAD)
Society for Information Display (SID)
Society for Imaging Science and Technology (IS&T)
Society of Plastics Engineers Color and Appearance Division (SPE/CAD)