Inter-Society Color Council *News*

Issue 459 Sep-Oct 2012

ISCC 2012 Annual Meeting
October 15-16, Manchester, NH

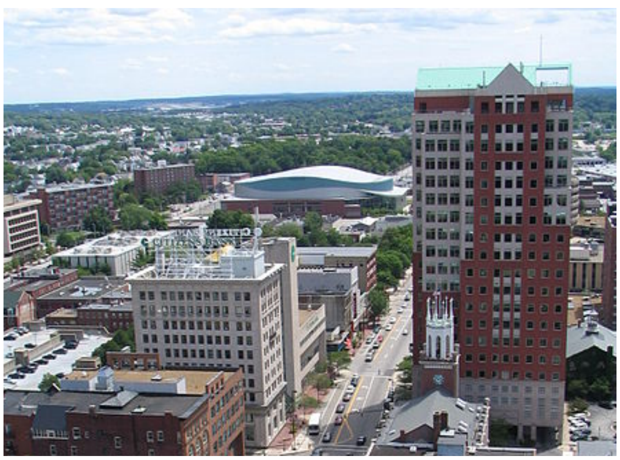
The program is complete, and we are now seeking attendees. The program is listed on page 2 of this newsletter. Please download the registration form from this link:

www.iscc.org/ISCC2012RegForm.doc

and register today. We have also enabled online registration and payment through paypal:

www.iscc.org/meetings/AM2012/register.php

(continued on page 2, including the program)



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The 2012 ISCC Godlove Award

Nominations are being solicited through Sept 15th

The Godlove Award is the most prestigious award bestowed by the Inter-Society Color Council (ISCC) to honor long-term contributions in the field of color. The Award was established in 1955 in memory of Dr. I. H. Godlove. The award is usually presented biannually with the next award scheduled for presentation at the 2012 ISCC Annual Meeting.

Candidates will be judged by their contribution to any field of interest related to color. The candidate's contribution may be direct, it may be in the active practical stimulation of the application of color, or it may be an outstanding dissemination of the knowledge of color by writing or lecturing, based on original contributions. Candidates need not have been active in the affairs of the ISCC, but they must be either current or former ISCC members. All candidates must have at least five (5) years of experience in their particular field.

A Godlove Award Nomination form may be obtained from the ISCC office. The past and present membership of the ISCC boasts a number of individuals deserving of such recognition and this award requires your participation in the process. Please take the time to consider and nominate a worthy candidate for this honor.

Download: www.iscc.org/pdf/2102godlove.pdf

Included in the nomination should be:

1. The nominee's name and contact information.
2. A citation giving in a sentence or two the specific reason for the award's bestowal.
3. A narrative up to one page in length covering the nominee's contribution and its significance.
4. A resume or vita and a publication list for the nominee, as well as any other useful material.
5. Source of the nomination. Give the name and contact information of the person(s) who prepared the nomination.

Note: Confidentiality is of the utmost importance. The nominee should be unaware of the nomination.

Eric Zeise
Godlove Award Chair eric.zeise@kodak.com

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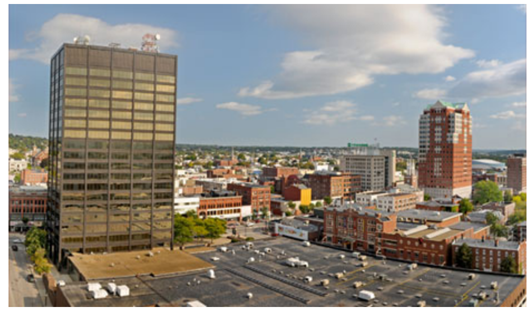


Manchester, NH

ISCC 2012 Annual Meeting Program

(as of Sept 5)

Rob Carter and Michael Brill
The Incredible Lightness of the Power Law

John Conant *et al*
Spectral Modeling of Surface Colors in Rural Outdoor Environments

Michael Brill
Illuminant-Dependent Von-Kries Primaries: A Way Out of the Sharpening Dilemma

Hugh Fairman
Uncertainty Analysis in Spectrophotometry

Tracy Lynn Phillips
50 Years Coloring the World of Plastics: History, Pioneers, and Mentors

Martin Bride
Sustainable Color

Anat Lechner, Leslie Harrington, Emanuela Frattini Magnusson
Color Versatility: Evolutionary Perspective

Anat Lechner, Leslie Harrington, Emanuela Frattini Magnusson
On the Premise, Promise and Complexity of Color Versatility in Built Environments

Jim Leland
Tutorial: *De-Mystifying Fluorescent Color*

We hope to see you all at the meeting in October! Register now, by fax, mail, or online at `www.iscc.org/register.php`

12th AIC Congress, July 8-12, 2013 The Sage: Gatehead, UK

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`.

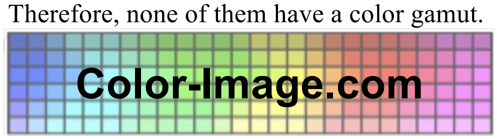
A Digital Camera Does Not Have A Color Gamut

Posted on August 29, 2012 by Parker Plaisted

Color gamut is a popular concept in digital color management, and is frequently mentioned in discussions about the selection of a color space (e.g., sRGB or ProPhoto RGB) or the compression of colors in a color-managed workflow. Color gamut volume and color gamut boundary colors are the two aspects of a color gamut that get the most attention, and both provide useful information.

Unfortunately, the concept of a color gamut has been applied to color imaging devices that do not actually have a color gamut. Only devices, or systems, that render color have a color gamut. To quote Dr. Roy S. Berns from RIT in the book Billmeyer and Saltzman's Principles of Color Technology, "Color gamut: Range of colors produced by a coloration system." To be a little clearer about this, the concept of a color gamut applies to systems that produce color (e.g., color printer, color television, color monitor, or color projector).

The concept of a color gamut is not relevant to systems, or devices, that measure color. In the context of digital color imaging, a color measurement device is exposed to colored light and delivers a set of digital values to represent that colored light. The obvious examples are colorimeters and spectrophotometers, which are used in scientific color measurement work. Digital color cameras and scanners are also color measurement devices. These devices do not render or produce color, they measure color. Therefore, none of them have a color gamut.



We can characterize a color measurement device, with some constraints on the exposure conditions, and use that characterization in an ICC profile for that device (e.g., an ICC profile for a digital camera or a color film scanner). But that characterization is not the same as a color gamut. The characterization may look a lot like a color gamut in a software tool that displays color gamuts and device characterizations, and that may be the reason why people think the concept of a color gamut is relevant for digital color cameras.

Another contributing factor to the confusion is the option on a digital color camera to choose an RGB color space (e.g., sRGB, Adobe RGB 1998, or ProPhoto RGB) for the encoding of a photograph within the digital color camera. These RGB color spaces are convenient color spaces that simplify color management of a digital photograph downstream from the digital camera. Encoding a digital photograph in one of these RGB color spaces will constrain the digital photograph to the gamut of the color space (Yes, each of these RGB color spaces has a color gamut that is constrained by the colorimetric values of the red, green, and blue primaries of the color space). It will also tie the digital photograph to the white point of the color space and establish the digital resolution within the color space (e.g., 8-bits per channel or 16-bits per channel). But the selected RGB color space is not the color gamut of the digital camera. If this distinction is not obvious after you have read the entire blog post, please leave a comment and I will go into more detail.

If we cannot apply the concept of a color gamut to a color measurement device, then how do we describe the capabilities and limitations of the color measurement device? The proper way to describe the capabilities and limitations of a color measurement device is to provide the color-matching functions of the device. The color-matching functions quantitatively describe the spectral sensitivities of the separate color sensors (e.g., red, green, and blue filters over separate light detectors). This becomes a little more obvious when you think about the color-matching functions for human vision. Human vision is a color measurement system, and we use the color-matching functions of the CIE 1931 standard colorimetric observer, or the CIE 1964 supplementary standard colorimetric observer, to quantify measured colors.

I recognize that it is easier to understand color management when we can see the color gamut of each device displayed in the same color space. I also recognize that a diagram of the color-matching functions of a digital camera lends very little insight when compared to a 2-D or 3-D rendering of the color gamut of a color monitor or a color printer. So I am sympathetic with the desire to give a digital camera a color gamut in order to facilitate a comparison to color rendering devices. The good news is that we have a simple solution: device characterization with a common colorimetric color space (e.g., CIELAB).

In the practical application of a color management system, the characterization of a color-imaging device is the information that enables color management. This is true for any color rendering device and any color measurement device in the digital color workflow. The characterization data, not the color gamut or the color-matching functions, are incorporated in an ICC profile. We see the characterization data when we use software tools to visualize the color volume and boundaries of the color-imaging device from an ICC profile. We should keep this in mind when someone incorrectly talks about the color gamut for a digital camera. We know that a digital color camera does not have a color gamut, but we can talk about the characterization of a digital camera, or the selection of a standard RGB color space within the camera, and frame the discussion in that context.

References:

R. S. Berns, Billmeyer and Saltzman's Principles of Color Technology, 3rd Edition, John Wiley & Sons, New York, N.Y. (2000).

ICC Profile Format Specification. (`www.color.org`)

`www.cis.rit.edu/mcsl/faq3#255`

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

HUE ANGLES

(Send contributions to mbrill@datacolor.com)

What's the big deal about Riemannian color space?

It's time for a serious essay, for a change….

At the last ISCC Annual Meeting (Nov. 2011, San Jose), Mark Fairchild presented a paper called, "Is there really such a thing as color space? Foundation of uni-dimensional appearance spaces." I quote from the abstract: "Color science is not devoid of examples of so-called color spaces that were actually descriptions of color perception one dimension at a time." Mark's examples ranged from the Munsell system (hue, value, chroma) to CIECAM02 (brightness, lightness, colorfulness, saturation, chroma, hue).

I believe Mark has begun the important exercise of deconstructing color science so as to reconstruct it in more fundamental terms without extraneous formalism. In a sense, we all must undertake such an exercise when asked to explain to a non-expert a complicated concept in color science. What is the essential purpose of the concept? What benefits does it confer, and conversely, what would happen if we abandoned the concept?

I was recently asked to explain to a non-expert audience the concept of a three-dimensional Riemannian color space, as used by two current authors. The authors simply wrote that the workings of tensor calculus made the concept "useful." This hardly answered the question of purpose or benefit.

To establish the historical connection and mathematical correctness, I looked at a retrospective work attempting to explain color-space geometry to theoretical physicists who were already comfortable with Riemannian spaces in other contexts:

"In 1666 Newton discovered that colors form a convex pencil in a linear vector space of three dimensions. In 1891 Helmholtz suggested a metric for that space; and by 1942 MacAdam had surveyed the experimental values of the metric. Meanwhile, Riemann, at the opening of his epoch-making address in 1854 on the foundations of differential geometry, had singled out the space of positions of objects and the space of colors as the only continuous manifolds of several dimensions in common experience. Later in that address he pointed out that a metric represents the effect of factors extraneous to the space itself---the result of what he called 'forces' acting upon it to bind it together. Riemann's suggestion has been brilliantly fulfilled in general relativity, where gravitation is the force that imparts a significant metric to space-time. In the space of colors, however, little has been done […] This paper outlines a theory of color space in which Riemann's 'forces' are essentially those of natural selection." [1]

Although dazzling, this passage doesn't get to the benefit or purpose. And certainly it doesn't give an intuitive sense of Riemannian geometry *per se*.

Accordingly, I made a try at an explanation. When we imagine color in a three-dimensional space, we are looking for a consistent arithmetic of color differences expressed as distances in the space. It is not enough to be able to compute a distance between any two colors (as can be done for such formulas as CIE DE2000). Intuition from, say, a topographical map in two dimensions, suggests (i) that there should be a path between the two colors along which the distances add; (ii) that path should comprise the shortest distance between the colors; and (iii) between any two points along the path, the shortest distance should be the part of that same path that connects the two points. Spaces with such defined paths are called Riemannian. If the paths are all straight lines in some coordinate system (as in CIELAB) the space is Euclidean.

After basking in the afterglow of effort, I realized that I still hadn't answered the original question. Why is the intuition of a contour map especially helpful in color space? How is that need met by a three-dimensional space with a Riemannian distance?

Perhaps we should start more primitively, and define the utility of a three-dimensional color-order system without the additional encumbrance of a metric. Johann Lambert in his 1760 book, *Photometria*, gave a compelling use case (quoted by Rolf Kuehni): "Caroline wants to have a dress like Selinda's. She memorizes the color number from the pyramid and will be sure to have the same color. Should the color need to be darker or go more in the direction of another color, this will not pose a problem." [2].

So if you have three perceptual dimensions and order your colors into a three-dimensional space,

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"Hue Angles" continued from previous page

you can find the color you want easily (without getting lost) by iterated change in the sensible directions. Seeing all the neighbors of a provisionally-chosen color gives guidance for the next iteration.

Now suddenly it is clear to me what Mark Fairchild's uni-dimensional scales lack. They don't allow you to see all of a color's neighbors. But here's a surprise: *Neither does the Riemannian space*, especially in the dehydrated metric-tensor form in which we usually see it. Truly, I can't determine all of a color's neighbors from that tensor. If I travel on a shortest path (geodesic) through color space, a neighbor I left long ago may be a neighbor I have right now, yet the locally characterized metric won't explicitly reveal it. As new Riemannian color spaces emerge (e.g., from "Riemannizing" color-difference formulas) we should be mindful of that fact.

I think Johann Lambert and—*a fortiori*—Rolf Kuehni identified the purpose of three dimensions, Riemannian spaces, and—most especially—pictures that transcend local description. What every shade sorter knows, we theoreticians should re-learn.

[1] Weinberg JW. The geometry of colors. *Gen Rel Grav* 1976; **7**: 135-169. [I omit references cited by the quoted passage on p. 135.]
[2] Kuehni RG. *Color Space and its Divisions*. 2003; Hoboken, NJ: Wiley, p. 55.

Michael H. Brill
Datacolor

Pantone Color Management Seminars

Pantone, (owned by sustaining member X-rite) would like to announce one-day intensive programs focused on professional color management, working with emerging color technologies and optimizing your color production workflow.

Pantone's new Creative Color Management Seminars have something for everyone. In two one-day programs, conveniently offered on consecutive days, graphic arts and textile design professionals will learn everything from best practices in color management to working with color trend forecasts, and how they affect each specific industry. You won't want to miss out on this opportunity to gain color knowledge and "C" the color difference in your workflow!

More information and online registration are here:
www.pantone.com/colorseminar

COLOR research and application

Color Research and Application IN THIS ISSUE, October 2012

We open this issue with two articles on color spaces and color difference formulae both from the University of Leeds. There has been a long standing question about whether specific color difference formulae can be used for evaluations outside the range of the data used when developing the formula. This has been especially questioned with the introduction of CIEDE2000, which was developed from data with differences under 5 CIELAB units. In order to answer this question, M. Ronnier Luo, Han Wang, Guihua Cui, and Haisong Xu present an "Evaluation of Colour-difference formulae for Different Colour Difference Magnitudes." In the experiments reported in this article three data sets with average difference magnitudes (large 50.3, medium 3.5 and very small 0.6) were used to test six color-difference formulae and uniform color spaces (CIELAB, CIE94, CIEDE2000, CAM02-SCD, CAM02-UCS, and CAM02-LCD). With the exception of CIELAB all formulae performed well; CIEDE2000 worked effectively for the full range of color differences. Also, the three color-space metrics based on CAM02 gave quite satisfactory performance as color difference metrics.

The CIELAB color space has been widely used for color applications. However, for color differences it has been shown that the newer color difference formulae perform better than CIELAB, but most do not have a color space associated with the color difference formula. Therefore the Commission Internationale d'Eclairage (CIE) set up a technical committee (TC 1-55: Uniform color space for industrial color difference evaluation) to develop a better color space. At the Beijing Institute of Graphic Communication, a large research program has been established to evaluate the color differences for graphic art applications, i.e. all based on printed materials. Our next article, "Testing Uniform Colour Spaces and Colour-difference Formulae Using Printed Samples" describes a new data set, which was produced to fulfill the requirements of CIE TC1-55. Min Huang, Hao Xue Liu, M. Ronnier Luo, and Guihua Cui evaluated ten color difference formulae and color spaces using this new

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"In This Issue" continued from previous page

data set. They found that all the tested formulae or spaces gave similar performance and performed accurately, except CIELAB and OSA, both of which had STRESS values over 32.

Next we move to the color vision area for an article on the "Behavior of a Periodic Chromatic Test with an Achromatic Ronchi Grating as a Field of Adaptation." The circumjacent area has a big influence on the perception of a color. These effects have been called the Bezold effect, assimilation effect, expansion effect or chromatic assimilation, among others. In this article Ignacio Tortajada Montañana, Jorge Montalvá Colomer and Mariano Aguilar Rico describe two experiments: one designed to study the influence that the grating contrast of a square achromatic grating had in the color perception (Bezold effect) of a red or green rectangular, and the other designed to study the influence of the grating's modulation ratio when the orientation of the grating is horizontal and the contrast is maximum.

Moving on to art, we have been publishing a series of articles by Antal Nemcsics on the "Experimental determination of laws of color harmony." In this issue we have "Part 6: Preparation of a system of color harmony indexes." In this installment Dr. Nemcsics describes how he developed a color harmony index number for pairs of colors by using observer evaluations of color pairs in compositions making a color harmony surface linked to the intersections with the coordinates in the Coloroid system. The color harmony surfaces and the distances between the related intersections indicate the harmony content of the color pair. The numerical values of these distances are called the color harmony index number of the color pair. This data made it possible to create an indexing system that expresses the color harmony content of all possible pair in color space.

For our next two articles, we move into business applications. First, Semiha Yilmazer, Elif Öztürk, and Sibel Ertez Ural report on "The Effects of Achromatic and Chromatic Color Schemes on the Participants' Task Performance and Appraisal in an Office Environment." While the achromatic office was evaluated as more formal and harmonious, in the chromatic office the 40 participants performed significantly better and reported the office to be more pleasant, attractive, satisfying and dynamic.

Then "The Affective Feelings of Colored Typefaces" are discussed by Wen-Yuan Lee, Shao-Yang Pai. Lee and Pai investigated both the typefaces themselves and colored typefaces. They found that the typeface generally is more influential than the colors on the impact of the typeface. The exception was that color was more influential on the characterization of friendly/serious and hard/soft feelings.

Our final two articles are in deal with consumer interests in color in ornamental stone and jewelry. Granite has become quite popular as a ornamental stone competing with ceramics and wood. While color is an important factor, so are gloss, grain size and shape, thus making measurement issues a high priority. The price of the material is highly dependent on the overall color appearance. In "Color assessment of granitic rocks and implications in their ornamental utilization," Luís Sousa and Bruno M.M. Gonçalves evaluate the factors affecting the assessment of granite color and the measurement techniques used to assess granites.

A relatively new procedure gaining popularity in the designers' world is the production of colored titanium jewels. Historically high-end jewelry was made from precious stones, such as diamonds and rubies, and noble metals. However, there is new interest in other metals, such as steel, aluminum, and titanium. For titanium, controlling anodic oxidation on the surface by changing the thickness of the surface layer allows different hues to be produced. Light passing through the oxide layer undergoes resulting in gradations of color on the metal surface. That is, the hue is determined by the optical thickness of the oxide itself. In our final article of this issue Maria Vittoria Diamanti, Barbara Del Curto, Valeria Masconale, Caterina Passaro, and MariaPia Pedeferri report on the "Anodic coloring of titanium and its alloy for jewels production." They analyze the possible applications of electrochemical coloring techniques to titanium jewels, discussing the crucial requirement of a good reliability of hue on differently finished surfaces.

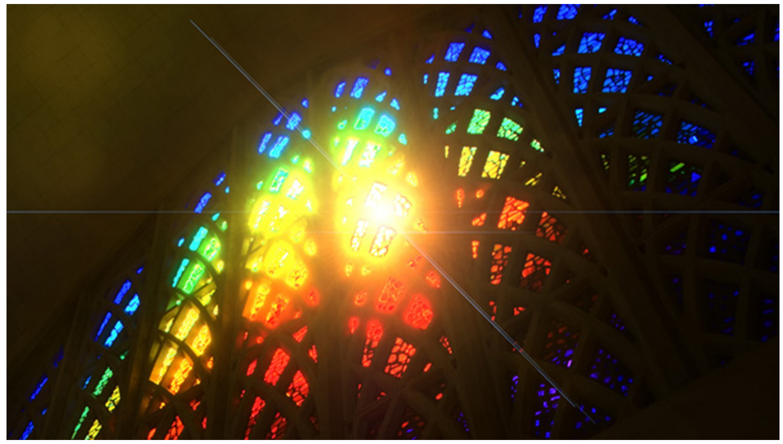
We close this issue with a book review and an announcement about a new publication. Danny C. Rich reviews *Statistics for Imaging, Optics and Photonics* by Peter Bajorski, and we preview the new publication, CIE Publ. 203:2012 A Computerized Approach to Transmission and Absorption Characteristics of the Human Eye coming from CIE Division 6 on Photobiology and Photochemistry.

Ellen Carter
Editor, Color Research and Application

Just how does a squid change color? Check out a new discovery in this Sigma Xi Smart Brief:
`tinyurl.com/8bfhjzh`

Metameric Blacks: A Color Curious Column

Ever wonder ... "Why colors of stained glass windows look so beautiful and different from other objects?"

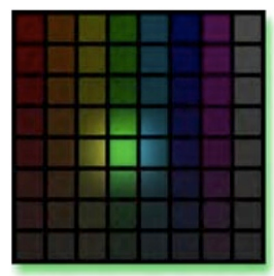


They look beautiful because they are beautiful! And it is our own preferences that determine what is beautiful.

Even though beauty is a personal choice, most people agree that the colors we see when looking at stained glass windows from inside a dark building are very beautiful. The same is true when we see the windows from outside at night and the lights are on inside the building. The special colors we see in the windows are caused by the way our eyes and brains perceive color. We are always judging colors in relation to other colors that are nearby. This lets us see that a black cat and a white piece of paper always tend to look black and white, even when the amount of light falling on them changes.

Stained glass windows take those comparisons to an extreme. The windows are often much brighter than their surroundings and that makes them appear to glow, much like the bright lights we see on Christmas trees or in fireworks displays. When colors are much brighter than their surroundings, they also look much more colorful to us. So, once again, it is how our eyes and brain work that makes the colors look so special.

As the image shows, we see stained glass as sparkling when we are inside a building because the colors are usually the brightest things we see. This picture shows a stained glass window with the sun right behind it. It took a special kind of photography, known as high-dynamic-range photography, to make this picture. Most cameras would make the glass look less colorful and less bright. A drink on me (at the next opportunity) to the first one to email me with the specific location of the window pictured.



Content of this column is derived from The Color Curiosity Shop, an interactive website, now also available as both English-language and Spanish-language books, 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

Calendar

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)
Nov 12-16	**IS&T** Color Imaging Conference, Los Angeles, CA www.imaging.org/ist/conferences/

2013

Jan 30-31	**ASTM E12** meeting at Hyatt Regency Riverfront in Jacksonville, FL.
Feb 3-6	**IS&T/SPIE** Electronic Imaging Symposium, San Francisco, CA www.imaging.org/ist/conferences/
Jun 26-27	**ASTM E12** meeting at NIST HQ in Gaithersburg, MD
Dec 12-13	**ASTM E12** meeting at Hyatt Regency Riverfront in Jacksonville FL

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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Thank You!

ISCC News Issue #459 Sep/Oct 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)