Inter - Society Color Council
Newsletter

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Michael Makin – President and CEO of Printing Industries of America speaking at the ISCC TAGA Conference.

Board of Directors Corner

My name is Rachel Schwen, and I'm bringing you this issue's Board of Directors column. I'm currently a senior chemist working in color science for performance coatings at Sherwin Williams and I've been an ISCC board member since the beginning of 2018.

Rachel Schwen, ISCC Director

I'd like to give you a brief recap of our annual meeting. In March 2019, ISCC joined TAGA (Technical Association for the Graphic Arts) for their annual conference. During the conference, the ISCC held a brief one hour working lunch annual meeting. At this meeting two marvelous things happened. First, Danny Rich of Sun Chemical recounted the founding of our society in 1931 (note the ISCC is 88 years old this year) as well as a brief history of the forms it has taken over the years. The gist of which was that the society's initial mission is very similar to the society's mission today. The goal of the council is to share knowledge related to color in dissimilar disciplines. The society has long stood as an authority of color knowledge broadly and has disseminated this knowledge to and from its member bodies.

Though the organization has grown and shrunk, been molded and shaped by its membership, and lived through some very real shifts in industry and economy, it remains steadfast to its initial goals.

The other marvelous thing to happen during our annual meeting was the conferring of the Godlove award. This is the most prestigious award presented by the organization and it represents a lifetime of contributions to the color community. The winner of the 2019 Godlove award was Danny Rich of Sun Chemical. The award was presented by Danny's longtime friend and colleague, Frank O'Donnell. Frank recounted a brief history of Danny's career focusing on his major contributions to color science. This included Danny's work which led to the creation of the first uniform color difference space, his work on inter-instrument analytics for color measurement devices, his work with ASTM on evaluations for precision and accuracy, and his contributions to education by excellent dissemination of knowledge of accurate color science. Danny then gave a more detailed retrospective of his career and expanded on each of these achievements. The meeting closed with president Renzo Shamey requesting attendance the following day at the ISCC long-term planning meeting. This discussion is vital to the longevity of the organization and if you were unable to attend and have ideas to contribute please reach out to Renzo Shamey or other members of the Board of Directors to make sure your ideas are heard.

Though the ISCC representation at the conference this year was small, there were several great sessions which will be recounted in other areas of the newsletter.

As planning begins for our next annual meeting, I reflect that each annual meeting is an excellent time to check in with colleagues, expand my color view, and be surrounded by people who understand the unique challenges color creates for each of us. I look forward to seeing you all again next year.

Best,
Rachel Schwen

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Annual Meeting

ISCC 2019 Annual Meeting was held Monday, March 18, 2019 in Minneapolis Minnesota.

The Inter-Society Color Council is the principal professional society in the field of color in the United States, encompassing the arts, sciences and industry.

The history of the Council dates to its founding in 1931, with the goal of advancing the knowledge of color as it relates to art, science, and industry. Each of these fields enriches the others, furthering the general objective of color education.
The current ISCC President, Renzo Shamey, presented the President's report which included:

1. Introduction of the new officers and directors

2. Acknowledgment of the outgoing members of the Board of Directors

3. Announcement of December 2019 elections

4. Plans for the next annual meeting

5. Announcement of the Godlove Award recipient.

President's Report

Outgoing Board

Outgoing Board Members: Paul Centore, Nurhan Becidyan, Simon Thayil, and Jodi Baker

Past President: Jerry Dimas
Outgoing Treasurer: Cameron Miller
Outgoing Secretary: Ann Laidlaw

The volunteer's service to the organization was recognized and is appreciated. The new board members were welcomed into the organization.

New Board

New Board Members: Lina Cárdenas, Danny Rich, Luanne Stovall and Amy Woolf.

President Elect: Dave Wyble
Treasurer: Frank O' Donnell
Secretary: Jean Hoskin

Renzo extended an invitation for members to volunteer and participate on the Board of Directors.

Highlights of the ISCC activities over the past year include: monthly board meetings, 10 webinars, Long Range Planning meeting, and the selection of the Godlove award recipient, Dr. Danny Rich.

The ISCC hosted a wide range of topics during its webinars. The date and title of the latest webinar was announced during the meeting. This webinar was held on March 21, 2019, which is the International Colour Day (ICD) and was presented by Prof. Michael Webster and covered "Adaption and Color Perception". The ICD was started by the International Colour Association (AIC) to celebrate color as a visual perception of the most influential phenomena in people's lives. Special thanks go to the Webinar Committee, and to Dave Wyble and Ann Laidlaw for bringing exciting topics and presenters to the ISCC membership and for their professional hosting and organizing of the events.

Another activity of the ISCC was the Long Range Planning meeting which was a result of the ISCC Munsell Centennial Color Symposium. Special thanks to Sherwin Williams for providing the venue for the meeting, which took place on Tuesday, March 19 and was led by Past President, Jerry Dimas.

The president then went on to introduce the latest recipient of the Godlove Award, which is the most prestigious award bestowed by the Inter-Society Color Council, and honors long term contributions in the field of color. The Godlove Award was established by Mrs. Margaret N. Godlove in memory of her husband, Dr. Isaac H. Godlove. The fund was presented to and accepted by the ISCC during the 25th Anniversary Meeting of April 6, 1956. The award is usually, but not necessarily, presented biennially in odd-numbered years. Dr. Danny Rich was recognized as the 2019 recipient and the award was presented at the meeting with the citation by Dr. Frank O'Donnell.

Finally, the next annual meeting will be held in June 2020 at Yale University with International Association of Color Consultants, North America (ACC-NA) and the theme will be Environmental Color and Color Education.

Treasurer's Report

The Treasurer's report was provided by Cameron Miller and Frank O'Donnell. Sun Trust balance is $60,562.89, PayPal balance is $5,547.80, and Bank of America balance is 9,829.69. Due to the low overhead costs of the organization, we remain in excellent financial shape. At the meeting, it was reported that the 2018 tax return is in preparation.

Secretary's Report

The president read a report prepared by Jean Hoskin, the current secretary for the council report.

The latest membership tally includes 164 paid active members, 8 honorary members, 111 individual members, 41 student or retired members, and 4 sustaining members.

Renzo Shamey

Frank O'Donnell

Cameron Miller

Jean Hoskin

ISCC TAGA Conference

Fritz Horstman

TAGA and ISCC joined forces for the 2019 Annual Technical Conference in Minneapolis, Minnesota. TAGA (Technical Association of the Graphic Arts) is a member body of ISCC, meaning that TAGA membership includes folks who care about the science, industry, or art of color (or all three!). The TAGA / ISCC conference was held March 17-19 at the Millennium Hotel, starting with an afternoon of innovative and out-of-the-box thinking from four keynote speakers:

1. Jeff Gomez, CEO, Starlight Runner Entertainment
Immersive Media: The New Language of Enchantment

2. Dan Dennehy, Head of Visual Resources, Minneapolis Institute of Arts
Imaging Cultural Heritage in 3D

3. Fritz Horstman, Artist Residency and Education Coordinator, Josef and Anni Albers Foundation
Interacting with Color: The Art and Teaching of Josef Albers

4. Daniel Dejan, ETC Print/Creative Manager, Sappi North America
This Is Your Brain On Paper

We came away from the afternoon keynotes with a fresh appreciation for immersive media experience, an understanding of how re-creating cultural artifacts can help us understand them better, a glimpse of the history of the Bauhaus and the impact that Josef Albers had on color education, and finally a reminder of the multi-sensory experience that is engaged by reading printed content.

The first technical sessions were held on March 18, and included two sessions on print process. The topics covered included measurement of lighting, recyclability of print, innovation on corrugated process, photopolymer development, UV-LED curing, narrow web, and on-demand for corrugated. There were two sessions on color-related topics: TAGA speakers presented on a new color vision test, using Kubelka-Munk for fiber blends, and the effect of color temperature on young and older viewers. ISCC speakers presented on digital textile printing: managing color, optimal ink selection, and on-demand printing applications. Afternoon sessions included new technologies: development incorporating smart materials, consumers' behavior with mobile technology, and spectro-densitometers. ISCC speakers explored color literacy in two unique presentations. John Seymour and Maggie Maggio enacted the challenges of communicating color between creative and technical teams, and Luanne Stovall and Maggie Maggio talked about their work on the 21st Century Color Literacy Project. The final sessions on March 18 were on Expanded Color Gamut (ECG), including optimal test charts and looking at color accuracy in expanded gamut process.

This concluded the portion of the conference for ISCC registrants. The ISCC held a Long Term Planning Meeting on March 19 at the nearby Sherwin Williams facility. TAGA registrants attended additional technical sessions on March 19 on print process, consisting of a presentation on measurement macro uniformity and marketing automation, and substrates, which included presentations on incorporating common milkweed and testing color reproduction on wide-format inkjet process. The print analysis session covered water-based soy inks, compostable films, and plate production. The final sessions on color included a review of digital color pickers, expanded gamut technology, the app based on Josef Albers' Interaction of Color, multicolor printing, and updated reference materials for spectrophotometer agreement.

A full list of speakers and titles can be found here: **https://www.taga.org/presentations/**

Awards Presentation
Godlove Citation and Acceptance Speech

The Godlove Award was established by Mrs. Margaret N. Godlove in memory of her husband, Dr. Isaac H. Godlove. The fund was presented to and accepted by the ISCC during the 25th Anniversary Meeting of April 6, 1956. The Godlove Award is the most prestigious award bestowed by the Inter-Society Color Council, and honors long term contributions in the field of color. Candidates will be judged by their contribution to any of the fields of interest related to color, whether or not it is represented by a Member-Body. A candidate's contribution is to be considered in the light of the objectives of the Council as defined in Article II of the Constitution. This 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 knowledge of color by writing or lecturing, based upon original contributions of the nominee. The candidate need not have been active in the affairs of the Council, but they must be current or former members of the ISCC. All candidates must have had at least five years of experience in their particular field of color. I can tell you that the nominating committee took very little time in agreeing that Danny meets all of the requirements for this award. Dr. Rich obtained his Bachelor's degree in Physics from the University of Idaho. He received a Master's degree in Physics from Virginia Polytechnic Institute and State University in Blacksburg, Virginia. He then went to Rensselaer Polytechnic Institute to get his Ph.D. His research advisor was Dr. Fred W. Billmeyer, Jr. The title of his thesis was "The Perception of Moderate Color Differences in Surface-Color Space". Danny has spent his life since obtaining his doctorate in the color industry. His first position after getting his doctorate was with the paint company Sherwin-Williams. I should at this point mention that his degree in color science from RPI actually says Chemistry. This is important because when he worked at Sherwin-Williams, management knew his research advisor was the well-known polymer chemist Dr. Fred W. Billmeyer, Jr. Given this background they tried to stop him from wasting his time in color and become a useful polymer chemist! Fortunately for us Danny resisted this and I believe at this point moved on to work for an instrument and software company, Datacolor International. Currently Danny works for a pigment company, Sun Chemical.

In the past Danny has served the ISCC as a member of the Board of Directors, as Secretary and as President (President-Elect and Past-President). He is currently on the ISCC Board of Directors for a second term. Danny received the ISCC Nickerson Service Award in 1999. He has also received the National Printing Ink Manufacturers award for Technical Achievement, a Thomas Alva Edison award for innovation by the Research Council of New Jersey, the Robert F Reed Technology Medal from the Printing Industries of America, and the Mattiello Memorial award from the American Coatings Association. Dr. Rich is Division Editor of CIE Division 8 on Imaging and has been a member of numerous CIE Technical Committees. Danny is a member of the Committee for Graphics Arts Technology Standards (CGATS), the ANSI technical advisory group on graphic reproduction, the Illuminating Engineering Society of North America (IESNA), ISO Technical Committee TC6 on Optical Properties of Paper, ISO Technical Committee TC130 on Graphic Arts, the National Printing Ink Research Institute (NPIRI). He is a senior member of the Optical Society of America (OSA), the Society of Imaging Science & Technology (IS&T), the Society for Information Display (SID) and the U. S. National Committee of the International

The 2019 ISCC Godlove award recipient is Dr. Danny Rich. The award was presented at the ISCC annual meeting in Minneapolis, Minnesota on March 18, 2019.

Citation given by Dr. Frank O' Donnell

Commission on Illumination (USNC/CIE). He has published on all aspects of Color Science and Engineering, including visual perception, instrumentation and mathematical modeling. I think I can safely say that Danny has the required "5 years of experience in his particular field of color" which seems to be pretty much every aspect of Color Science!

Looking over his work in color to date the committee would like to pick out for special mention the following:

He developed the first uniform color difference space. This work was in conjunction with Dr. Ernst Rohner and was later adopted by DIN and became the German DIN 99 color space and color difference formula.

The committee also noted his work on verifying the performance of Color-Measuring Instruments. Two papers he published with Dave Wyble in CR&A are well worth taking the time to read. The next parcel of work we would like to commend is his activity with ASTM, in particular his work on precision and accuracy evaluation making use of multivariate statistics.

Finally Danny has not neglected the dissemination of color knowledge through education. He has been particularly active in the printing industry through publications and answering questions relating to color science in various media formats.

His long-term contributions to color can be summarized by a comment made to me by one of his colleagues "Danny advises the experts!". It is therefore my pleasure to present to Danny the 2019 ISCC Godlove Award for a lifetime of service to the field of color." Citation given by Frank O'Donnell.

Dr. Frank O'Donnell (left) presenting the Godlove award to Dr. Danny C. Rich (right).

Acceptance speech by Dr. Danny C. Rich

"I have to express my thanks to the ISCC Board of Directors and the Godlove Award committee for bestowing this honor upon me. I have to say that when Renzo phoned me, I was caught completely by surprise. Since this is an award for a lifetime of achievement in the field of color, I thought that I would describe how I came to be here today.

My undergraduate studies were begun in 1969 at the University of Idaho, studying Physics. Like most undergraduate programs, a physics major is exposed to a large number of topics. But I was fortunate in that three of my professors were active in research in various types of optics, including interferometry, refractometry, Raman scattering and holography. So while I started university, looking to study medium energy particle physics, I ended up studying laser physics and holography. My undergraduate research project was a redetermination of the pressure of light. We used a torsion balance to measure that force applied to a target by a monochromatic beam of light. In 1973 I began my graduate career at the Virginia Polytechnic Institute. I joined a group that was using holography to do matched spatial filtering. That is probably a term that is unfamiliar to most of you, but it is a form of optical metrology in which a hologram is used to filter out objects by their shapes and then one can count what remains. The technique has several uses but for this team, it was part of a project with the Fresh Water Institute to determine the populations of several species of fresh water diatoms, silicon shelled microbes in the water and soil. The method is purely binary, it can sense the presence of a shape but not the size.

So, I was given the task of building an instrument for assessing the sizes of these microscopic creatures suspended in water.

On my way to VPI that summer I had stopped in the south suburbs of Chicago to visit a friend from my undergraduate days. He introduced me to one of his friends who worked at the Sherwin-Williams Research Center, then located in the Pullman District of Chicago. He suggested that I apply for an internship and I arranged for an interview later in the year. Since they were also interested in particle size, they offered me a summer internship for the summer of 1974. So it was that I began my industrial career, though I had never planned it to be so. I had chosen VPI because they had a program in post-secondary education, and I was looking to become an instructor in a small college or junior college. While at SW that summer, they had a consultant on polymer and resin development come through, they knew that he had done light scattering in his studies on polymer science and thought that I might enjoy meeting and speaking with him. It turned out, that the consultant was professor F. W. Billmeyer, Jr., from Rensselaer Polytechnic Institute. He asked me many questions about my research and gave me some excellent advice on how to improve the measurements.

At the end of the meeting, he asked what I was planning for my PhD studies and I indicated that I had no plans, at the moment, since this was during the time that NASA was downsizing after their moon landings and the market was flooded with applied physicists. He suggested that I consider his program in Color Science at RPI. Later that fall, I visited RPI and several former students wrote to me about the job possibilities which seemed far brighter than physics education. In the fall of 1975, I transferred to RPI and the Rensselaer Color Measurement Laboratory.

My background in optical instrumentation made me somewhat unique in the lab full of physical and analytical chemists. I quickly learned the features and quirks of the instruments in the color lab. The RCML had a lot of measurement equipment. Our primary instrument was a General Electric Hardy scanning spectrophotometer and the secondary instrument was a Zeiss DMC 25 scanning spectrophotometer. We also had a Kollmorgen KCS-40, an instrument not widely used in industry. It was the grandfather of the KCS-18, which was a very popular instrument in the textile and coatings industry. It was like an X-Rite 939 or eXact on steroids. It has a spinning filter wheel with 40 filters.

Then in the summers we had short courses and for those courses, the commercial vendors of color instruments would send examples of the equipment to RPI for us to demonstrate in our laboratory exercises. So, I got to see new instruments and how the technology of color-measurement was evolving. VPI had two areas of renown, at this time, the metrology of atomic and sub-atomic collisions and turbid medium theory. So, I assumed that I would take metrology or turbid media for my research in the RCML. But Fred had other ideas. He had just graduated Dave Alman and Dan Phillips who had published on these two subjects so he suggested I choose another area, such as color differences. But I never lost my interest in metrology and improving instruments for the measurement of color. In 1980, I joined the Sherwin-Williams Research Center, where I was initially asked to construct a goniospectrophotometer, similar to what DuPont had done in creating their Multi-Angle Colorimeter. I was also involved in the acquisition and setting up of a low-angle light scattering detector for liquid chromatography. Eventually, I became the group leader for special instrumentation, technical computing and the model shop. Later, the senior management felt that politically, they could no longer support a central Research function and steps were underway to transfer individuals out of the central role into the various business groups. I chose instead to join Applied Color Systems and Ralph Stanziola. At ACS I expanded my knowledge of radiometry and photometry. I found that even smart color technologists can suffer from the syndrome where, "... learning to use a hammer meant that everything looks like a nail..." They were characterizing fluorescent light sources using 20nm steps and a wide bandpass spectrometer. They also calculated their photometric data using the familiar CIE 1964 standard observer. It was difficult for me to convince them that their (x10, y10) chromaticity values were not the correct values for a D65 simulator. I also learned about CRT displays and their optical transfer functions and how to measure and calibrate them. At this time, ACS was part of Armstrong World Industries and was the darling of their noncore divisions. Much of their flooring was produced by printing a pattern on paper and then laminating the pattern to a durable resin. So, they had a graphic arts design center with all of the latest computer tools. It took permission from senior management for a non-team member to get entry, but I was allowed to see the system.

So, I was already learning about digital prepress when most print shops were still using contact prints and ruby-lith. But a hostile take-over attempt forced AWI to divest itself of non-core business and ACS was sold to a Swiss holding company, the Eichhof Group. The Group already owned a small Swiss color company, Datacolor, AG who was well known in the European textile and paper industry. Shortly after, Eichhof also acquired Instrumental Colour Systems from the UK who were also the major player in textiles in the UK and China. Each of the three companies had developed software for QC and matching and one or more instruments to work with the software.

(continued on the next page)

(Acceptance Speech by Dr. Danny C. Rich continued)

Trying to consolidate three different instrument designs, all of which were fully compliant with CIE requirements, uncovered an ugly truth about color measurement – "The Emperor has no clothes!". The CIE specifications were too broad to provide measurement scales that were consistent across implementations. Around 1990 it became apparent that the traditional approach to optical design was not going to carry this technology into the 21st century. The GE-Hardy, the Zeiss DMC 25, the KCS-40 all had footprints of about 15 square feet, and most of that was the optical bench. The modern instrument had footprints of about 2 square feet and less than half of that was the optical bench. One could adjust the wavelength scale and bandwidth of the double prism monochromator of the GE-Hardy but there is precious little to adjust on an eXact, SpDens or Datacolor 45. The sensor spacing is measured in microns. We had observed that stressing the optical bench by touching in the right place can be enough force to shift the spectral image by several nanometers. I had predicted that these traditional mechanical optical adjustments would need to be corrected using smart mathematics. That has come true in today's instruments, where the hardware, by itself, is not capable of providing the performance required for meeting the ever-tighter tolerances of commercial production of color products.

At the same time, I followed the work of Alan Robertson and Roy Berns on instrument modelling. Their methods could identify gross errors and correct for some of them, but they could not bring about the level of correction required. So, I studied this problem with my colleagues, Alan Ingelson, a physicist from the UK and Denis Martin, a mathematician and programmer from Switzerland. I knew that forced calibration was not enough to guarantee consistent performance. I had seen instruments, built to very tight specifications, tested and pass rigid requirements in the production facility. Moved 100 feet across a parking lot and be retested and fail the same set of tests. The model needed to be robust and it needed to insensitive to the random variations of the environment. The simple divided differences as estimates for wavelength and bandwidth variations were not adequate. They amplified noise, especially if either the wavelength or the reflectance scales were stored as integers. Denis had an algorithm for interpolation that could produce smoothly varying first and second derivatives from a spectral curve based on a publication from Sandia Labs. Next, we found that the models were not always consistent. Often the predictions were worse than the uncorrected readings. This often occurs in regression due to heteroscedasticity. Alan had a suggestion for a type of weighted regression using the reflectance reading as the weights. It is well known that in color measurements, the noise is higher for high reflectance than for low reflectance. Alan and I worked together to find a level of quieting that would provide the most robust predictions using a very stable weighted regression algorithm. This resulted in our ability to take good instruments and make them even better. More importantly, to take mediocre instruments and make them good. It allowed us to take the instruments from the three former companies and run them in a lab, side-by-side with acceptable results. In the field, tests showed that standard targets produced in the lab on a reference instrument could be read in the field on a production instrument with a level of agreement well below the product tolerances. We took this achievement and presented it to a CORM conference. It was well received but it highlighted one additional issue. The scales to which instruments in different parts of the world were linked were not in agreement. At one point, around the time of Color77, the national laboratories felt that they were in good agreement.

But my testing showed that this was no longer true in the late 1980s. Only recently have I seen reports in Metologia indicating that bilateral tests are showing good agreement once again. But one has to ask, is this level of "good" in the sense that I have a 3 ½ digit voltmeter and I can verify the output of my USB port to 5±0.002 volts? Unfortunately, it is not that good yet. But many of the properties that plagued commercial instrument production have been solved. The wavelength scale and the bandwidth are now controlled to better than 0.1 nm. This means that the contributions to the uncertainty from that source is measured in hundredths or thousandths of a percent. This was achieved by using wavelength intervals and bandwidths of 1.0 nm. Most of commercial instrument still use 10 nm intervals and 10 nm to 15 nm bandwidths. This is like trying to measure a line to 0.1 mm using a rule marked with 1.0 cm lines.

In the study that we did on the instrument modelling, we identified one other issue that most readers seem to have missed. The instrument model was based on readings from 420 specimens. Some were paints, some were glossy ceramics, some were plastic and many were textiles with different weave patterns. If I modelled with ceramics, I could see good results on ceramic specimens but not so good on textiles. If I modelled with paints, I could get good results on paint and plastic specimens but not so good on ceramics or textiles. There was a concomitant variable due to the geometry of the instrument and the surface structure of the specimens. I demonstrated this once to Harold Van Akken, a Macbeth Award winner for his work on profiling of instruments. He developed a model for an X-Rite handheld instrument using ceramic tiles. The model was excellent, the color differences were below 0.1 CIELAB unit. I then compared some packaging ink samples to their Pantone standard. The results were far worse, in fact they were worse than before the model was applied. But why should this be, Harold asked?

I led a CIE Technical Committee that looked into this question. What we found was the CIE requirements of any aim angle less than 10° is equivalent to 0° might be OK for pressed PTFE but it does not apply to commercial materials. Similarly, the requirement that cone half-angle be less than 5° is also not applicable to many materials. Working with Dr. Gorow Baba of Murakami, in

Japan, we found that the aim tolerances should be ±0.5° and the aims should be 0° or 8°, nothing in between. The cone half-angles should 2° ± 0.2°. This was published more than a decade ago and was in the previous and current revisions of the CIE recommendations on Colorimetry—but has still not been incorporated into any commercial instruments.

This award citation identifies my work on the color difference problem, even though I spend most of my career in optical metrology. In particular, the ISCC cites the work that I did that led to the development of DIN99. This work began during one of my visits to Datacolor, AG in Switzerland. Dr. Ernst Rohner, the founder, had been to several meetings with some textile producers who wanted a color space that mapped differences that would be comparable to those predicted by the very popular CMC equation.

While meeting with him, he commented that the weighting terms, (1/1+SL) and the similar ones for SC and SH has a similarity to the first terms in the Taylor expansion of the logarithm. So he wondered if it might make sense to build a color space based on log(L), log(C) and then develop new a,b axes. He took a large collection of data from some textile producers in Germany and computed DECMC(2:1) around them. Then looked for coefficients to map the new L,a,b coordinates to the differences predicted by the simulation. I looked at the predictions and they seemed to be not as uniform as I would expect. I took the Munsell renotations and plotted them and the Yellow-Blue axis did not scale the same as Red-Green axis. We added an expansion factor to the b* axis. This worked very well. The differences were still consistent and the mapping was now very uniform.

We prepared a paper for the AIC meeting in Berlin. The presentation was well received and we named the equation DCI95. The meeting planned to publish the papers in the journal Die Farbe and I suggested that we publish the paper in German since the data came from the German textile producers. Dr. Rohner liked the idea but did not feel confident in the translation of my English to high German, since he spoke Swiss-German. He asked our mutual friend, Klaus Witt from the BAM in Berlin to assist. Klaus spoke both excellent German and technical English. The paper was thus published in German and as a result is not well known in the U.S., but it raised a lot of excitement in Europe and especially with Klaus; who extended it and promoted it with the German automotive industry who submitted it to the DIN for standardization. The success of the DIN99 equation was more due to Klaus Witt than to Ernst or myself.

In looking back on my career in color technology, I am disappointed that so much of what I have done was kept as trade secret. Even the papers that I did publish did not disclose all of what I had learned. On more than one occasion, I have had to ask forgiveness from management for what I had disclosed. It seems that as the years have passed, this scenario is becoming more frequent. When you look at the ISCC and its history, much of that history was founded on research from industry. Today, it can be difficult to get permission to come to an ISCC or a TAGA meeting unless you are a senior person with your own budget.

When I first started at Sherwin-Williams, I had a senior VP confront me saying that he thought all problems in color technology had been solved. Based on the careers of a lot of my former classmates and colleagues from around the world, I would say that a lot has been accomplished in the last 40 years. I think products like ColorMuse from Variable, Inc. will revolutionize the technology. Here is an instrument that is basically, no better than the Hunter Lab filter colorimeters that I first used in 1976. But its use of mathematics and embedded machine learning allows it to correct its readings to be consistent with the measurement systems of a supplier of decorative coatings. I have heard, though I have not seen this, that it can also be set up to be consistent with the swatch book of a textile dyer. I feel somewhat validated, that my predictions have come true and the technology of mathematics is being used to improve and make colorimetry more affordable to the general public. Hopefully, the recommendations on the improvement of colorimetry that have been published over the past 40 years will be adopted or at least incorporated through mathematical modelling to the state that we can finally say, "We think that all problems in color measurement technology have been solved."

Hopefully, the recommendations on the improvement of colorimetry that have been published over the past 40 years will be adopted or at least incorporated through mathematical modelling to the state that we can finally say, "We think that all problems in color measurement technology have been solved.

Thank you,
Danny C. Rich, Ph.D.

Event: TAGA Meeting - Conference Summary of ISCC Portion

Session: Textiles

Scott Donovan, BluePrintCreative Managing Color with Digital Textile Printing

Scott Donovan

This presentation discussed factors that impact color management in digital textile printing. These included the challenging areas of process control, ink and substrates, plus hardware and software. Textile printing is difficult. There are many steps in the preparation of fabric for printing as well as the printing process itself. Scott gave interesting examples, such as a knit fabric may be stretched when printed and the colors will be darker when the knit contracts. Inks and substrates are a critical match. Dye classes must be selected for the specific fiber content and process. Color tolerances in textile evaluation are very tight. Hardware and software are constantly evolving to match customer demand. It is essential to stay current.

Components of the process included preparation of fabric as well as age, storage and coatings on substrates. The digital workflow includes design, color workspace, and file type. Printer inkset and gamut impact colors available to the designer.

Expanded inksets are a response to the need for more and deeper colors. The process requires a temperature and humidity-controlled print room environment and dyes require a post printing process. In software there are different RIP engines, profiles, calibration techniques, color spaces, and the visual appearance of the device colors.

One approach to color management does not fit all. Attention to detail in the digital workflow and knowledge of textiles are required to make it work.

One of the biggest issues is managing your customers' expectations. This is a growing industry. Currently digital printing is only 3.5% of the printed textile industry and projects a growth of 20% per year.

David Clark, Huntsman Textile Effect. Which Ink Do I Use?

This presentation is an overview of the different types of textile inks and how they are applied. Textiles for digital printing require preparation and also post-processing to ensure great color and durability.

David began by defining essentials of basic ink chemistries, characteristics, and how inks are selected. A digital textile ink may contain a variety of elements. Some are water, dye or pigment, humectant, viscosity modifiers, dispersants and surfactants, binder for pigment, and an antimicrobial. Reactive inks are suitable for cotton, rayon, linen and silk. They make a covalent bond with the fiber under controlled conditions and have very bright shades with good wash fastness. Acid inks form an ionic bond in the presence of acid and provide bright colors. They are suitable for nylon, silk, wool, and leather. Disperse dyes are also known as sublimation dyes. With the addition of heat the dye converts to a gaseous dye that is extremely attracted to and soluble in polyester. When cooled, the dye is entrapped in the fiber. Disperse inks have good wash and light fastness. The market for these dyes is signage, fashion, and sportwear. The emerging market is in technical textiles such as home, automotive, outdoor furnishings, banners and flags. Pigments can be used for most fibers since they are applied using a binder. They have good light fastness but poor rubbing

fastness. Reactive and acid processes require pre-treatment, drying, after print steaming, and washing after fixation. Dave included tricks of the trade to make these processes more successful. The direct print disperse process includes pre-treatment, drying, thermos-fixing or steaming, then washing. An alternative to direct print disperse is a transfer process, where dyes are printed onto a specially treated transfer paper and the image is pressed against the fabric with heat applied. Pigments are the simplest process. The fabric may be pretreated before printing. The fabric is dried and heated to cure the binder.

Dave showed several images of steaming and washing equipment for digitally printed textiles. As with the previous presentation, it is clear that a thorough knowledge of textile processing is required.

Kerry Maquire King, Spoonflower On Demand Textiles and the Colorful Challenge of Web to Print.

The web to print business model presents a set of challenges for image workflow and color management for digitally printed products. Factors include printer platform, substrate, ink chemistry, and finishing. This presentation highlighted unique characteristics of print on demand and opportunities for technology development that meet customer expectations for textiles purchased via the web.

In the model Kerry presented, customers could be B2B or B2C, who are looking for unique, custom, or DIY products. E-commerce customers are looking for an easy online experience where products are quickly found, ordering is understandable and web tools inform and empower. Customers prefer rapid delivery and product performance. Product appearance is a key customer expectation. The digital environment allows for orders that are small with lots of variety, so the process must be flexible, efficient, and have automated workflow and systems. At Spoonflower, the customer can shop the marketplace for a design or upload their own. The digital workflow has to be flexible with file types and profiles, repeats or engineered prints, design styles from painterly to photographic, and limited or full color palettes.

Digital printing also allows for a waterless process which is significant in the textile industry, has minimal processing, is better for the environment, and has quick job turn-around for 1000s of orders per day. More flexibility is introduced using printer platforms for both pigment and dye sublimation. Customers can request fabric by the yard or as home textiles on 20 different fabrics plus paper.

Managing flexibility and efficiency is important to on time delivery but managing the color expectations of the customer is critical. It is important to reproduce the design intent from preview to print. This means accurately illustrating what has not yet been produced. Customers want consistency across fabrics and repeatability. "Santa needs to be red". In textiles it is not only the color; the drape and texture of the fabric also influences selection.

Two challenges of the digital printing industry are color and 3D rendering technology. The color management challenge includes color space, ink sets, fabric characteristics (fiber, texture, whiteness, hand feel, ink load), pretreatment and post treatment. The 3D rendering challenge impacts product visualization. Pictures in catalogues may not be photos, but 3D renderings of products that have not been produced. This provides rapid generation, high quality, fidelity to end product, and easy ordering, especially from a mobile device.

The same design can be placed on multiple products, such as draperies, pillows, or sheets to encourage multiple customer purchases. This presentation illustrated exciting opportunities in areas of color process improvement, textiles research, technology development, and e-commerce strategies.

David Clark

Kerry Maquire King

Luanne Stovall (left) and Maggie Maggio (right)

Report on the TAGA Literacy Session by Maggie Maggio

ISCC hosted two talks during the Monday afternoon Color Literacy session of the Joint TAGA/ISCC Annual Technical Conference. The first talk, "The Grand Canyon of Color: How To Talk Color Across the Creative/ Technical Divide" was a humorous look at the difficulty of communicating color specifications between designers and printers. John Seymour played the part of the frustrated but helpful printer and Maggie Maggio acted as the inexperienced, just starting out graphic designer.

After a few difficult crossings between studio and print shop, John and Maggie came up with three suggestions to improve communication. Early in the process, the designer and printer should work together to:

1. Calibrate monitors to a standard condition.
2. Define the paper type for the project.
3. Choose the best printer profile for the project.

They built a bridge over the divide by realizing it was important to start every project as a team. The second talk in the Color Literacy session was an introduction to the Color Literacy Project. Maggie Maggio and Luanne Stovall shared information about the 21st Century Color Literacy Project, a newly formed, long-term initiative led by the ISCC to identify misinformation about color in education and promote updated color competencies relevant to 21st century industries and disciplines.

Before launching the Project Committee, Maggio and Stovall participated in the Color Literacy Problems Committee to clarify the underlying issues in color education across disciplines. In addition to Maggie and Luanne, the Problems Committee included Robert Herschler, Stephen Westland, Robin Kingsburgh, David Briggs and Paul Green-Armytage. For this TAGA session,

Maggio and Stovall presented their perspectives as color educators on the need for a new, multi-disciplinary, foundational color curriculum. Stovall spoke first from the perspective of re-framing color education at the university level. She presented information on the speaker series that she is currently coordinating as part of The New Color, an elective color course for all majors she is teaching this spring at The University of Texas, Austin. The popular Wednesday night "Color Salons" are free and open to the public and pair guest speakers with color-focused topics. For more information on the Color Salons, see **https://art.utexas.edu/sites/files/aah/poster_the_new_color.pdf**

Stovall described the color field as a dynamic phenomenon relevant to sensory perception, communication and visual literacy—not just for artists and designers, but for everyone. The long term goal of The New Color program is to reframe COLOR as a robust multi-disciplinary STEAM (Science, Technology, Engineering, Arts, and Math) Learning Model at all educational levels, structured with clearly defined competencies aligned with 21st century industries—in order to enhance communications across all disciplines for more informed, inspired, and effective solutions. Maggie followed Luanne with her perspective on building a strong foundation for learning about color by transforming how color is taught to children from pre-school through high school. Maggie presented on her five-year collaboration with VIBE of Portland, a non-profit providing arts and music education in Portland, Oregon. Maggie's "Color Explorers in the Classroom" program trains the staff of VIBE to teach color starting at age three by using hands-on explorations with light and pigment. By integrating the art and science of color, very young students are experiencing color as more than just mixing paints. One of the key findings of the Color Explorers program was the lack of elementary school educational materials for teaching basic color concepts that are consistent across disciplines, easily accessible, and affordable for teachers. While the current K-12 educational standards in the U.S. include the requirement to teach about color in both art and science, the curricula is not integrated to reflect the multi-disciplinary nature of color. The Problems Committee found that one of the fundamental challenges in updating color education for the 21st century is that the current U.S. standards in art are based on teaching the Red, Yellow, Blue (RYB) system of primary colors. A preliminary survey of 100 art teachers across the country found that over 75% teach using an RYB color wheel. Another challenge is the lack of awareness of the three-dimensionality of color with only 4% of teachers using any kind of color space. Given the advances in digital technology and the fact that computers are available in most classrooms, the opportunity to teach color in 3D is now possible at all ages. Maggie and Luanne presented just two perspectives on the need to re-imagine color education for the 21st century. The members of the Color Literacy Project Committee bring many more perspectives to the table. The committee is preparing a full proposal document to ISCC/AIC by June this year to report on the findings of the Problems Committee and to outline a course of action for updating color education across all ages and disciplines. Stay tuned!

Maggie Maggio

John Seymour

Albers Workshop at TAGA

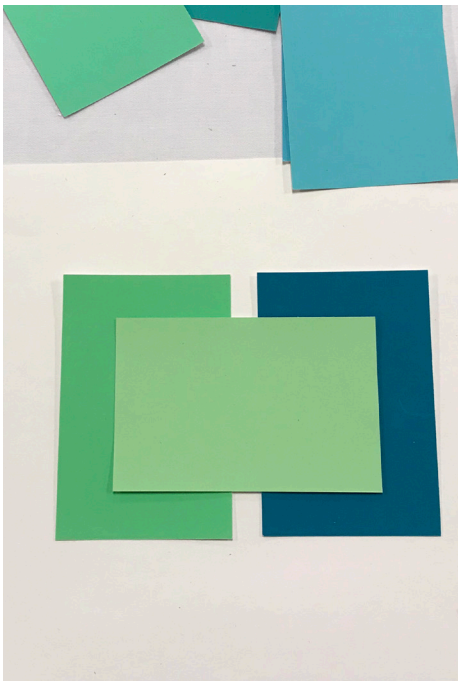
At this year's ISCC Annual Conference, held in conjunction with TAGA (Technical Association of Graphic Arts) in Minneapolis, the Council sponsored a pre-conference workshop focused on the color exercises of artist and educator Josef Albers. (See **https://albersfoundation.org/artists/biographies/.**) The workshop was led by Fritz Horstman, Artist Residency and Education Coordinator for The Josef and Anni Albers Foundation (**https://albersfoundation.org/**) in Bethany, Connecticut.

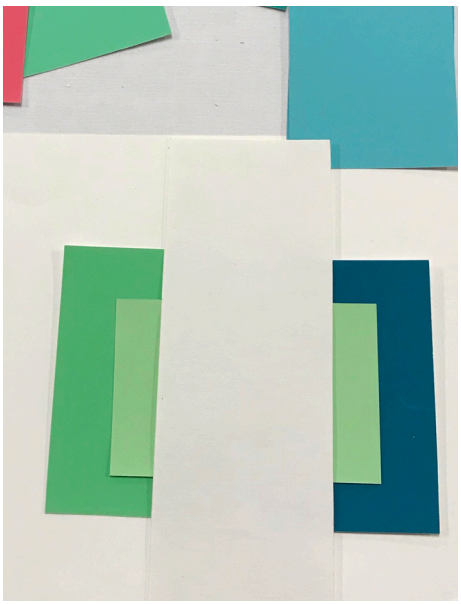
Attendees from both TAGA and ISCC participated in the series of exercises, taken directly from the approach developed by Albers at Black Mountain College in the 30s and 40s. They later became central to his teaching, after his appointment as Chairman of the Department of Design at Yale University in 1950. Albers' best known works Homages to the Square are a direct result of his single-minded focus on the interaction of colors.

Albers' technique with students was not to teach them about how colors interact, but rather to "lead students to their own discovery of color." Similarly, Horstman gave us a few hints about strong colors and weak colors, to set us on our own road to discovery, but otherwise provided no specific instruction.

Using sets of Color-Aid paper, our first exercise was to make three colors appear like four. The challenge was to find a set of two colors that, when used as a backdrop for the third, would shift that third color to appear visually different. We used a narrow strip of white cardstock to isolate each side of the third sheet of paper to check our combinations. Albers referred to the discrepancy in appearance as "the actual fact vs. the factual fact."

Subsequent exercises included making four colors look like three and working with two colors and finding the gradient of three colors between the original two. True to the Albers tradition, all of these exercises were gathered up at one end of the room and then analyzed by Horstman and the workshop attendees. We discussed what worked and proposed theories as to why. There were no right or wrong answers, but rather a deeper understanding of how colors can impact the colors around them. We are optimistic that Fritz will join us again in 2020 for the ISCC joint conference with the International Association of Color Consultants - North America to further our connection to the Albers pedagogy.





Long Term Planning Meeting - Conference

Thank you to Rachel Schwen, Frank O'Donnell and the Sherwin-Williams Company for hosting this meeting.

In attendance: **Jerry Dimas, Luanne Stovall, Amy Woolf, Ann Laidlaw, Jodi Baker, Maggie Maggio, Danny Rich, Renzo Shamey, Dave Wyble, Rachel Schwen, Frank O'Donnell, Jean Hoskin.**
Connected online: **Paula Alessi, Mary Mello, Ellen Carter.**

March 19th, 2019.

Goal

Our goal was to address issues and list action items.

There were 5 main topics of discussion intended to generate ideas on how best to grow and sustain our base. It was agreed that whatever actions that might be implemented would need to be sustainable, especially when it involves students.

Main Topics

1. Students – Support student memberships, scholarships, challenging activities, use social media, YouTube, and internet to attract.

2. Education – AIC education committee work to ISCC project committee, coordinated programs at different platforms and age groups, use resources to train industry on new technology/lighting.

3. Membership and Marketing – Establish contacts, what do we offer them and what do they offer us?

4. Leverage "Inter"- Society – Cross-discipline, networking, information exchange, papers

5. Apply all of the above to the 2020 conference, target items that will impact conference, outreach to regional universities and schools.

Ideas / Action Items

Some of the ideas generated include:

1. Future Meetings focus on education. Art, science, and industry people attend. We could serve schools, industry, and the public at large.

2. Who are we? Can we connect to member bodies? Do we have people for liaisons?

3. The ISCC needs to market color to these organizations. Do we need a marketing and membership person?

4. Action item to Member Bodies: What we can do for you? What you can do for us? Promote in reports, snapshots.

5. How do we revitalize? Can we expand into other areas of color? (lighting, pigments, fundamentals). Can we leverage "INTER" society?

6. For example, ISCC has not presented lighting (LEDs) recently, but AATCC and IES have. It could be inter-society because it impacts lighting standards. Graphics uses (D50) and Textiles (D65). They do not have LED evaluation. What about LED in museums?

7. Munsell provided interest in all the different disciplines, see from another perspective.

8. What are the action items? Who is affiliated with other organizations? Each person should identify their affiliations.

9. Publish what the different orgs are doing DCC, CORM, CMG and SPE. Each organization meets their own needs. They have a depth of knowledge and a library of resources.

10. Bring back more interest to publish papers, and project to our member bodies.

11. Create a YouTube channel with basic color information and links to ISCC information.

12. What can we do to entice student funding and sustainability?
regional universities and schools

Warm regards,
Jerald Dimas
ISCC Past-President
Color Communications, LLC.

ISCC Webinar for International Color Day

Dr. Michael Webster, Adaptation and Color

The ISCC was honored to host an outstanding webinar in observance of the AIC International Color Day on March 21, 2019. Dr. Mike Webster of the University of Nevada, Reno captured the attention of 100 attendees during his presentation on Adaptation and Color. Since the attendees are muted, we did not hear everyone's "oohs" and "ahhs" as he presented powerful images on a variety of adaptation experiences. ISCC members are familiar with the phenomenon of complementary after-image, in which an observer who stares intently at a colored image for 30 seconds or so will then see an image of the complementary color and same approximate shape when they then turn their gaze to a white field. Dr. Webster's presentation demonstrated that adaptation is not limited to color: when observers stare at an image of a compressed (distorted) face, then a normal image appears expanded and distorted. When observers stare at a fuzzy image of a face, then a normal image appears hyper-focused. The effects of adaptation are powerful and complex. Without getting inside each other's heads, maybe we really do see the same colors, thanks to adaptation

Please join us for future webinars here: **https://iscc.org/events**

ISCC members can view recorded webinars here: **https://iscc.org/SeminarSeries**.

ISCC Webinar February Summary

Kristen Dettoni, Print on Demand - Exploring the Market Opportunities

Kristen Dettoni shared her experience and expertise regarding various "print on demand" solutions that are commercially available to professional or casual designers. The webinar was hosted by ISCC on Feb 19, 2019, and attracted approximately 40 attendees, including artists and industrial practitioners. Our next generation of customers, the iGen, expect their needs to be met on their terms.

With the rapidly evolving world of technology and manufacturing, companies are well positioned to offer custom products designed and made to their clients' specifications. Working as a designer in commercial interiors, I see potential for custom designs and products in a variety of settings. The use of print technology provides the opportunity for each space to afford its own unique experience. Kristen demonstrated the capabilities of several providers of print on demand textiles and paper.

Kristen is an accomplished designer with 27 years of experience in design, management, and marketing. Several of those years were spent at textile mills, designing and developing woven products for automotive, office, hospitality, and healthcare. Over the course of her career, she designed the first sustainable seating and automotive textiles and was awarded a patent for automotive suspension seating. Kristen recently founded Design Pool, an online resource for licensable patterns specific to residential and commercial interior products, such as upholstery, wallpaper, bedding, pillows and privacy screens.

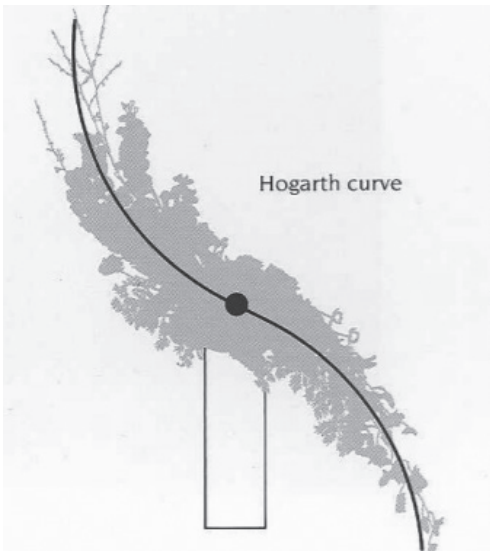
She is extremely passionate about the future of print on demand and customization. Her versatility and devotion to all things creative, makes her approach to product development and design truly unique. If you missed this webinar, you can view the recording here if you are a current ISCC member: **https://iscc.org/Members-only-content**

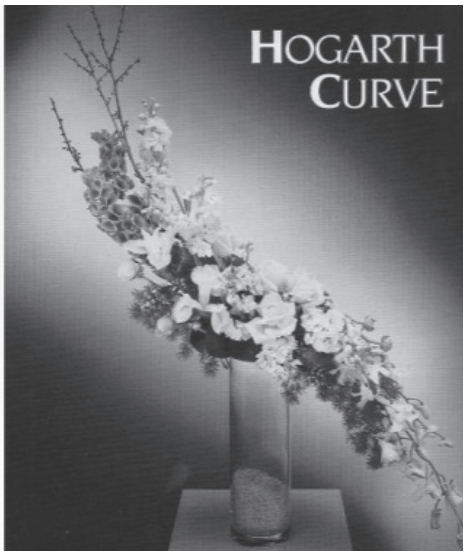
Hue Angles: the mathematics of flower arrangement

I have just returned from the Philadelphia Flower Show. The theme was "flower power" and it featured music and visual references to the 1960s. Because I learned most of the math I know in the 1960s, I searched restlessly for something that would resonate with that memory. (Yes, contrary to popular belief, I both lived through the 1960s and remember them.) Eventually I found a curiously mathematical-sounding reference in a description of flower arrangements: the Hogarth curve. A spray of flowers was described as a Hogarth curve if the dominant elements comprised or suggested an s-shaped form.

To the consternation of my companion, I immediately started searching for Hogarth curves on my phone. There was no mathematics--the curves had been used to describe the aesthetics in drawing, painting, and flower arrangements, and their name derived from the "line of beauty" extolled by William Hogarth in his 1753 book, The Analysis of Beauty. Hogarth was an 18th-century English painter and writer. He (and many subsequent flower arrangers) saw s-shaped curves as signifying liveliness and activity that cannot be found with straight lines or other curves. I found no mathematical or scientific discussion of Hogarth curves, so I will now speculate on an interpretation.

There is one special point on an s-shaped curve called the point of inflection. It is in the middle of the curve, and is the point where the curvature changes from negative to positive. In other words, it is a point of zero curvature. Imagine looking at an s-shaped curve drawn on a flat sheet of paper, and noting (with a very sharp pencil) the point of inflection. Now change your point of view (e.g., slant the paper away from you) and re-image the figure with a pinhole camera. Surprisingly, the point of inflection of the new image is exactly at the image of the point you noted with the pencil. The point of inflection is an invariant of the perspective projection.





This invariance is a mathematical property of projective geometry (which includes perspective). A projective transformation sends any straight line into another straight line. It is more general than a linear transformation because parallel lines when mapped may converge; the meeting point is called a vanishing point. When you look at an s-shaped curve, there is only one point of that curve whose neighborhood is a straight line, and that is the point of inflection. Three points on the curve can be made as collinear as desired by moving them closer and closer to the point of inflection. Since the neighborhood of the inflection point is a straight line segment, the segment will stay at the same part of the s-curve when that curve is projected to another planar image.

What does this have to do with Hogarth's praise for s-shaped curves in art? It might be that the inflection point is anchoring a moving viewer to a distinct point in the picture, relative to which all else is swirling around. By being a view-independent feature, it may be an effect opposite to the elusive smile of the Mona Lisa, which (as explained by Margaret Livingstone at Munsell 2018) is a low-spatial-frequency rendering that is noticeable only in peripheral vision, which sees with much lower resolution than our fovea (center of vision).

In any event, this tiny vestige of math in the middle of flower arrangements may allow me to revisit the 1960s with a sense of entitlement to its memories.

Michael H. Brill
Datacolor
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COLOR
RESEARCH AND APPLICATION

Summary: June 2019 Issue

Assessing Color Performance of Whole-slide Imaging Scanners for Digital Pathology

In the fields of medicine and pathology, modern advances are leading to the replacement of light microscopy by slide imaging scanners. In the first article of this issue Wei-Chung Cheng, Firdous Saleheen, and Aldo Badano discuss their study of the color performance of two commercial scanners, comparing them to ground truth and to a hypothetical monochrome scanner. In the article, "Assessing color performance of whole-slide imaging scanners for digital pathology" they describe a multispectral imaging system to measure the color truth of biological tissue samples, thus eliminating the need of using man-made color targets. This whole-slide imaging scanner technology provides a new paradigm of scanning, viewing, analyzing, managing and sharing pathological images digitally.

Sensor Inter-pixel Correlation Analysis and Reduction for Color Filter Array High Dynamic Range Image Reconstruction

Staying within the field of imaging, the next article is "Sensor inter-pixel correlation analysis and reduction for color filter array high dynamic range image reconstruction." While the definition of Inter-pixel processing seems obvious, its purpose is partly to perform early vision processing, not merely to capture images. In this article Mikael Lindstrand uses the term Inter-pixel correlation to include an aggregate of the six distortion concepts of optical crosstalk, charge diffusion crosstalk, the so-called "brighter-fatter effect", blooming, inter-pixel capacitance, and smear in a color filter array sensor. He presents and implements a calibration method that facilitates the detection, analysis and reduction of inter-pixel correlation in the affected neighborhood of saturated pixels in the low dynamic range of the color filter array sensor images. This improves the low dynamic range portions of an image with over or under estimates of the signal to noise ratio and, consequently, also the HDR reconstruction.

Color Research and Application IN THIS ISSUE Vol. 44 Issue #3, June 2019 By Ellen Carter

Segment-Interpolation and Gamut Mapping Application of Segment Maxima Gamut Boundary Descriptors

The next article deals with not only the capture of color images but also with the mapping of the images to a different device, whose gamut may well be quite different from the original source image gamut. If one cannot do a one-to-one mapping from the gamut of the original to that of the other device, it often is useful to examine the boundaries of the color gamuts of the two devices. Two approaches to defining the gamut boundaries are convex hull calculation and segment maxima gamut boundary descriptors. However, these can lead to the problem of empty segments or holes when mapping the gamuts together. Ming Zhu and Yuanyuan Zhang discuss this problem in their article, "Segment-Interpolation and Gamut mapping application of Segment Maxima Gamut Boundary Descriptors," and their psychophysical experiments are employed to evaluate the preference and accuracy of the gamut-compressing operator. Then they report on the testing and verification of the computational efficiency of gamut boundary descriptor and gamut mapping operators.

Further Investigation on the Modified Hyperbolic Function in the CAM16 Color Appearance Model

Not very long ago, a new color appearance model CAM16 was introduced [see Comprehensive color solutions: CAM16, CAT16 and CAM16-UCS. Color Res Appl. 2017; 42: 703-718]. Now in this issue most of the same authors report on a study exploring various possible extensions to the non-linear luminance adaptation function, which was used in both CIECAM02 and CAM16. This new study was initiated because while the modified hyperbolic function seems reasonable from physiological evidence, it has some other drawbacks. One is that the infinite slope when the argument q equals zero causes instability for both for the forward and inverse modes of the CIECAM02/CAM16 models.

Therefore, Zhifeng Wang, Cheng Gao, Yang Xu, Yang Xu, Manuel Melgosa, Michael H. Brill, Michael Pointer and Changjun Li tested four possible extensions. In "Further Investigation on the Modified Hyperbolic Function in the CAM16 Color Appearance Model", they recommend one of the extensions as well as upper and lower limits of the luminance range for the use of CAM16.

Optimization of Color Design for Military Camouflage in CIELAB Color Space

Camouflage is an interesting and challenging area in color science, whether you are trying to hide something or someone, or whether you are trying to find a particular object target. It is most often considered in the context of military activities, but there are other applications in document security and business. No matter the application, one needs to consider the visual issues of color and spectral data. Both sides of the camouflage are interested in assessing how good the camouflage is.

Therefore, Chiuhsiang Joe Lina, Yogi Tri Prasetyoa, Nio Dolly Siswantoa, and Bernard, C. Jianga present a new and practical approach for enhancing the selected military camouflage by utilizing Response Surface Methodology in their article, "Optimization of Color Design for Military Camouflage in CIELAB Color Space." Based on their findings they present a new design guide for the enhancement of selected military camouflage, which can also be applied to military weapons, military structure, and even military vehicle camouflage.

Chromatic Interior Environments for the Elderly: A Literature Review

The article is "Chromatic interior environments for the elderly: A literature review" by Anna Delcampo-Carda, Ana Torres and Juan Serra. With scientific advances the world is developing an aging population, with life expectancy increasing. With aging, people experience decreases of their functional and sensory abilities, including visual impairments, but these changes do not necessarily mean there must be negative changes in daily life activity. This review article focuses on seventeen studies of color and the elderly, published in the last 20 years, which examine the architectural adaptations including the influence of color on visual comfort in the physical environment. It shows which architectural adaptations maintain or improve performance for elderly people. Sharing these findings between health professionals, designers, and architects makes it possible to generate initiatives that could improve health and wellbeing, and increase the participation of the elderly within their communities.

Characteristics of Pigments, Modification and their Functionalities

For those more interested in how to make physical colorants, Bismark Sarkodie, Collins Acheampong, Xun Zhang, Benjamin Tawiah, and Benjamin Asinyo provide another review article. Their article is "Characteristics of Pigments, Modification and their Functionalities." The use of colorants started early in recording history by rubbing mashed berries, organic ashes, and colored stones onto walls of caves. However, pigment science has developed since then. These authors describe many types of both organic and inorganic pigments, their general characteristics and factors leading to the desired color. They discuss the distinguishing factors that affect the characteristics of pigments such as the class, crystal structure, particle morphology, particle size, hiding power, pigment volume concentration, surface character and surface treatments including polymerization, which alter either the optical, conductivity or the ability to be dispersed during processing and application.

This review summary coupled with the extensive reference list will be a handy tool for those learning about pigments.

Describing Natural Colors with Munsell and NCS Color Systems

As people used more and more colors they began developing collections and organizing colors into models or systems. These systems are used in many ways, including communicating desired colors for products or in projects, determining harmonies and color relationships, and for some numeric systems – quality control of products.

Currently two of the most commonly used systems that are organized into books of colors—the Munsell Color System and the Natural Color System—are used for systematic visual identification of colors. In the next article, "Describing natural colors with Munsell and NCS color systems," Ruben Carpinteiro Pastilha, João Linhares, Ana I.C. Rodrigues, and Sergio M.C. Nascimento compared the colors of natural scenes with the colors represented by these systems under a wide range of illuminants. Their goal was to determine whether these two systems encompassed the colors found in natural scenes, and represented these colors well. They found that both systems did a better job of representing natural colors of moderate and high lightness than those with low lightness, which are found naturally in shadows or dim light levels.

They explain that to obtain a complete match to the natural colors contained by the color systems, thresholds of 7 and 5 CIELAB units would be required for Munsell and Natural color systems, respectively.

Unique Hue Judgements using Saturated & Desaturated Munsell Samples Under Different Light Sources

Most color systems have some form of trichromatic organization. Two examples are Munsell Lightness, Hue, and Chroma, or CIE tristimulus values of X, Y and Z. These coordinates form the basis for the system's organization. Therefore, color order systems allow the systematic study of color qualities. One quality that has been studied for over a century is "unique hues."

Despite individual variations, there are four hues that generally are identified as unique: "red", "green", "blue", and "yellow". Unique red means that the red has no yellowness or greenness. In this issue, Hsin-Pou Huang, Minhen Wei, Kaida Ziao, and Li-Chen Oh explored what observers would identify as these unique hues at different lightness levels and using different light sources.

In "Unique Hue Judgements using Saturated & Desaturated Munsell Samples under Different Light Sources" they report that the correlated color temperature of the light source significantly affects the observers' judgments, but Δuv was found to significantly affect the judgements on unique yellow. Also, the iso-lines of the unique yellow, blue, and green judgments did not always go through the origin of the color appearance model being examined (CIECAM02, CIELAB, or CAM02-UCS).

Quantitative Representation of Floral Colors

The next article, "Quantitative Representation of Floral Colors" uses the CIE 1976 L*a*b* system, which is based on CIE tristimulus values, for representation of their data.

K. Athira, N.P. Sooraj, R. Jaishanker, V. Saroj Kumar, C.R. Sajeev, M.S. Pillai, M.S. A. Govind, A. and V. K. Dadhwal became interested in the similarities and differences between human perception and methods of communication than that of other species. So they studied comparing how humans and pollinators such as bees perceived floral colors.

Bees' photoreceptors are primarily activated by photons in the ultraviolet, blue and green areas of the spectrum. Their article compares how humans and bees, which pollinate the flowers, perceived floral colors and reports the dominance of human-perceived red and yellow flowers in the study region with the appearance of blue-green and green constituting the dominant insect pollinator perceived floral colors.

A Cross-cultural Clustering Study of Similarities and Dissimilarities Across Cultures Based on Concept Words Cheap, Reliable and High Quality and their Corresponding Color Association

"Big data" and "Data mining" are two new catch phrases that have caught people's attention recently and become new fields of analysis. Big data refers to very large collections of data collected and stored electronically for researchers to access. Data mining is the process of organizing the data in which to look for or find pertinent information.

Our next article compares the results from using data mining to more traditional statistical analysis techniques, such as K-mean clustering, principal component analysis and multi-dimensional scaling.

In the next article Ahsan Abdullah compares the information discovered by and the conclusions drawn from the analyses of "A cross-cultural clustering study of similarities and dissimilarities across cultures based on concept words cheap, reliable and high quality and their corresponding color associations."

Importance of the Color of Light for the Illumination of Urban Squares

The next two articles deal with outdoor lighting as it relates to the architecture of towns. In cities and towns, outdoor lighting has many uses such as providing guidance for pedestrians, increasing a pedestrian's sense of safety, and advertising for commercial establishments in the area. It also adds an ambiance that can affect the whole town and its unique character. The lighting designer should take these issues into consideration and balance them with the ever present requirements of system cost, including materials and maintenance. In the article, "Importance of the color of light for the illumination of urban squares," Aleksandra Cabarkapa and Lidija Djokic report on a study done with over 150 advanced architectural students to determine the relevant parameters. The results are divided into 18 parameters, divided into two groups: the first including the overall impression and the basic and most important lighting aims devoted to safety, security, orientation, visual comfort and amenity; while the second group includes parameters related to lighting features which can have positive effects, but frequently negatively influence the overall impression.

An Investigation into the Impact of Daylight on Perceived Color of Façade: Understanding the Role of Chromaticness

While the preceding article considered artificial lighting to be used for nighttime from the point of view of the lighting designer, the second article focuses on the

building architect and the nuances of daylight on the buildings. This article is "An Investigation into the Impact of Daylight on Perceived Color of Façade: Understanding the Role of Chromaticness." Since the authors understood that commonly the color for the façade of buildings is often selected within the confines of the architect's office, it is important for the architect to know the effects of natural daylight on that façade color as it changes diurnally. Karim Asarzadeh, Ramin Madani, Forough Mahyar, and Mohammad Reza Nilforoushan performed an experiment where 100 subjects compared the color seen on the façade to Natural Color System standard color samples and chose the closest match. Then, they measured the differences between the selected samples for the same "designated" color and analyzed the results.

Their conclusions describe how the chromaticness of a façade color may determine the extent to which color variations occur as daylight conditions differed between direct sunlight and skylight.

Surface Characterization of Wood Treated with Boron Compounds Combined with Water Repellents

The last two articles in this issue deal with the effect of treatments on two different materials. Wood is commonly used in the construction of houses and other outdoor items, such as lawn furniture. However, over time the weather affects the color and finish of the wood. Although we think of paint as decorative and making our house our own, the foremost reason for using paint is protection from the effects of sun and weather. Over the years many chemicals have been used to give added protection to wood, but how much do they help? One may have to wait years to determine the effectiveness. Ahmet Can and Hüseyin Sivrikaya discuss the "Surface characterization of wood treated with boron compounds combined with water repellents."

They compare artificial weathering to natural weathering to determine the effectiveness of this new treatment.

Do Repeated Firings Affect the Color Properties of Porcelain-fused-metal Restorations that are Fabricated Differently?

The materials used for dental restorations are carefully chosen for the strength and ability to withstand the wear and tear in a person's mouth, but also for their color properties in order to give a natural appearance. In recent years the manufacturing techniques for making restorations has changed greatly. Rapid manufacturing techniques involving computer-aided design have decreased the turnaround time and accuracy of making the restoration. In the fabrication process selective laser sintering and selective laser melting have added the needed adaptability to the process for a personalized restoration.

However, in this process the restoration may be exposed to repeated firings. So Ersan Çelik and Ayca Tulga asked "Do repeated firings affect the color properties of porcelain-fused-metal restorations that are fabricated differently?" They found that indeed that is true; the color does change with each firing. So they suggest that a maximum of six repeated firings is recommended, so that the color change will not be above the acceptable limit observed for restorations carried out by laser sintering with annealing and a maximum of eight repeated firings can be recommended, so that perceptible color change will not be observed, in restorations carried out by casting, milling, or laser sintering without annealing.

Additional Columns and Reviews

Besides the fifteen articles in this issue, there are four additional items. First, in the Communications and Comments column is a "Comment on 'Optimization of a Spectrally Tunable LED Daylight Simulator' " by Geoshao Zhang, Ke Ding and Guoxing He. Besides commenting on the previously published article, these authors follow up that article by reporting on simulating AA-grade daylight simulators using six, five, and four channels. Next in the area of publications, Michael H. Brill reviews the book, Progress in Colour Studies edited by Lindsay W. MacDonald, Carole P. Biggam, and Galina V. Paramei.

Also, the International Commission on Illumination (CIE) announces the publication of technical report, COL3083 CIE 230:2019 Validity of Formulae for Predicting Small Colour Differences, which is the result of the work on Technical Committee 1.81 which has the same name as the report. Finally, Minchen Wei presents an erratum for [Wei M, Yang B, Lin Y. Optimization of a spectrally tunable LED daylight simulator. Color Res Appl. 2017;42(4):419-423.].

A Blast from the Past: ISCC Newsletters 50 Years Ago

ISCC Color Information Bureau

Did you know that ISCC formed a Color Information Bureau late in 1968, as reported in ISCC Newsletter No. 198 January-February? Fifty years ago, there was a need to "communicate color information" to a variety of color-interested groups and to improve the quality of color information that was disseminated to these groups through color courses or other means. What I find amazing about this piece of ISCC history is that today, in 2019, this need still exists. Let's explore the evolution of the ISCC Color Information Bureau from its inception.

Warren L. Rhodes, otherwise known as "Dusty", was ISCC Past President and champion of the formation of the ISCC Color Information Bureau. Its purpose was "to encourage and assist exhibitors, authors, lecturers, teachers, and schools to communicate color information, and to improve the quality and effectiveness of exhibits, lectures, articles, books, movies, and color courses." This Bureau was treated like an ISCC Problem Committee with Dusty as its Chair. It had a very ambitious eight-part scope:

"1. To develop a library for the loan or sale of color illustrations in the form of printing plates, slides, movies, and printed materials.

2. To solicit artifacts and provide technical assistance to museums.

3. To subsidize and provide technical assistance to colleges and universities which wish to expand or improve teaching and research in color.

4. To produce audio-visuals for loan or sale, including movies, slide presentations, and displays.

5. To develop a list of audio-visual materials and teachers' aids available from any source.
6. To establish a list of speakers to be provided on request.

7. To subsidize publishers of books and articles on color and to provide technical assistance when appropriate.

8. To survey the teaching of color in schools and to recommend a course of action of ISCC, if appropriate."

Since the scope consisted of so many parts, it was decided to conduct the work in groups. Dusty proposed that the following groups be formed: Museums, Audio-Visuals. Library, College and Elementary Education, Catalog of Illustrations, List of Speakers, Publishing and perhaps Exhibits. These groups would conduct their work simultaneously so the purpose and eight-part scope could be completed in a timely fashion.
In the 1969 March-April Annual Meeting Issue of ISCC News (No.199), President Fred W. Billmeyer, Jr. stated the following purpose of the Color Information Bureau: "The purpose of the Bureau is to coordinate the gathering and dissemination of information, advice, and assistance (at times material) on any aspect of color at whatever point it is needed."
In the same issue, its Chair, Warren L. Rhodes, added that the Groups were beginning to form and Chairmen were being named with more information to follow in newsletters later in the year. He added that the ISCC Board wanted the Speaker Group to work with Member-Bodies to help them in the development of color symposia for their meetings.

In the 1970 July-August Issue of ISCC News (No. 207), incoming Past President, Fred W. Billmeyer, Jr. and new Secretary of ISCC could not devote the time necessary to chair

the Color Information Bureau. So, Karl Fink was named Chair of the Bureau to succeed Warren L. Rhodes. It was decided that the Chair of the Information Bureau should be a continuing appointed position and not turn over every two years to the Past President so that there would be continuity and stability in this very important position. Karl gave his report on the progress of the Bureau. The Board approved the establishment of six Groups:

Education Group – Richard Hunter, Chair.

Illustration Group – Nick Hale, Chair.
Speakers Group – George Ingle, Chair.

Museum Group – Christian Rohlfing, Chair from Cooper Union Museum (otherwise known as Cooper Hewitt Museum) .

Exhibits Group – Chair still needed.

Bibliography – Chair still needed

It was noted that each group would have to submit a scope statement to the Board for approval.

The final installment that I was able to locate on the ISCC Color Information Bureau was the 1971 January-February Issue of ISCC News (No. 210). It was a report from Richard S. Hunter as Chair of the Education Group entitled "Survey of College for Courses on Color or Appearance". Richard sent a letter and questionnaire to about 200 colleges and technical schools from the Blue Book for the United States and Canada asking about courses offered in color and/or appearance. As of the publication of this 1971 newsletter, Richard had received 20 responses mostly from institutions teaching courses in art, design and architecture. He was awaiting responses from engineering and scientific schools. Richard speculated that the lack of responses and the slow rate of return was due to the fact that the questionnaire did not have simple yes or no questions on specific course subjects. Richard wanted to follow up with a revised questionnaire, but he was seeking help on preparation of a good list of specific course subjects, especially in the art, design and architecture areas.

After this 1971 entry, the trail for the evolution of the ISCC Color Information Bureau went cold. I am not sure if it was because the members became inactive or because the groups broke off into other entities with new names within the structure of ISCC. This effort seemed like a very worthwhile one that was just as important in the 1970s as it is today in the 21st century. I would like to see two things happen from my writing of this article. First, if anyone knows what happened to the ISCC Color Information Bureau after 1971, please email me at geinhaus@frontiernet.net so that I can complete the evolutionary trail. Second, as ISCC looks to establish a long-range strategic plan, I know many of us are interested in spreading accurate color information in the sea of erroneous color data that we find every day in social media and on the World Wide Web. The Color Literacy Project started by Maggie Maggio goes a long way toward addressing some of these issues, but the scope of this Color Information Bureau was even broader. Does ISCC want to pursue things like a Speakers Group or an Illustrations Group or a Museum Group? If any of this strikes your fancy, please feel free to contact any Board member listed on page 2 of this newsletter or me at the above email address. ISCC is the premier national color organization for the United States of America. Let's be the color experts for those who need help and may not know it!

Paula J. Alessi
Color Scientist

Warren L. Rhodes (Dusty)

AIC Midterm Meeting 2019
Color and Landscape
14-17 October 2019
Buenos Aires, Argentina

Call for papers

On behalf of the International Color Association, the AIC 2019 Organizing and Scientific Committees, invite you to participate and submit abstracts related to the theme of the meeting: “Color and Landscape”. The theme covers different aspects of the landscape, including its visions, constructions, and configurations.

The concept of landscape has a double existence: the observer and what is observed. It can be thought of as having natural and social configurations; a product of actions and interactions of nature and humans; a perception by a social group and individuals. The landscape has an objective and subjective character; it is a social and cultural construction, a visual reality and a mental image, a transformation from the idea of terrestrial surface to that of identity in a society.

Color and landscape can be described, written, perceived, drawn, painted, remembered, lived, walked, traveled, thought of, colored, represented, prefigured, created, designed, inhabited, symbolized, transformed . . . from literary, physical, pictorial, cultural, patrimonial, archaeological, anthropological, psychological, historical, philosophical, aesthetic, sociological, geographical, topographic, or epistemological points of view, among others.

Submissions will be accepted in any of these orientative fields and topics:

Fields	Topics	
Landscape design	Color in urban landscapes	Crop detection by color
Architecture	Color in urban furniture	Color in aerial photography
Lighting design	Color in urban trees	Color in satellite images
Urban planning	Color in transportation	Color in geography
Agronomy	Color in natural landscapes	Color coding in maps
Geography	Color in virtual landscapes	Digital color
Ecology	Color and cultural landscapes	Color under the sea
Psychology	Color in industrial landscapes	Color changes according to season
Literature	Color identity & color heritage	Color changes according to latitude
Arts	Color and tourism	Color changes along day and night
Engineering	Color descriptions in literature	Color in horticulture and gardening
Chemistry	Color in landscape painting	Color of flowers
Physics	Color and urban art	Color of the sky
	AIC Study groups involved	Language of color Arts and design Color education Environmental color design Color vision & psychophysics

Submission procedure

See the details and steps for submission at: http://aic2019.org/submission-dates

The selection and peer reviewing of abstracts are carried out by the international scientific committee: http://aic2019.org/organization

email: isccoffice@iscc.org
address: 7820B Wormans Mill Rd. Suite #115, Frederick MD 21701

Calendar 2019

May 3	CMG 2019 ChromaZone® Vancouver, Centura Tile, Vancouver, British Columbia Info: https://colormarketing.org/event/chromazone-vancouver/
May 14-17	IS&T 2019 Archiving Conference, Lisbon, Portugal Info: https://www.imaging.org/site/IST/IST/Conferences/Archiving/Archiving_Home.aspx
May 23-25	ICA-Belgium Colour Symposium, KU Leuven Ghent Technology Campus, Ghent, Belgium Info: https://coloursymposium.org/
May 24	ICC Color Expert Day, Bressanone, Italy Info: http://www.color.org/events/bressanone/index.xalter
Jun. 10-13	CFP: International Conference on Predictive Vision, Centre for Vision Research, York University, Toronto, Canada Info: http://www.cvr.yorku.ca/conference2019
Jun 13-14	ASTM E12 Meetings, NIST, Gaithersburg, Maryland Info: www.astm.org
Jun 16	3rd workshop on Visual Understanding by Learning from Web Data, Long Beach, CA. Info: http://www.vision.ee.ethz.ch/webvision/workshop.html
Jun 16	4th New Trends in Image Restoration and Enhancement workshop, Long Beach, CA Info: http://www.vision.ee.ethz.ch/ntire19/
Jun 17	First International Workshop on Dynamic Scene Reconstruction, Long Beach, CA Info: https://dynavis.github.io/
Jun 17-22	CIE Quadrennial Meeting, Washington, D.C. Info: www.cie.co.at
Jun 20-22	8th Iberian Conference on Perception, San Lorenzo de El Escorial, Madrid, Spain Info: http://eventos.ucm.es/26555/detail/8th-iberian-conference-on-perception.html
July 15-19	Light and Color in Nature, College of the Atlantic in Bar Harbor, Maine Info: http://lightandcolorinnature.org
July 29-Aug 1	15th annual Asia-Pacific Conference on Vision, Ritsumeikan University, Osaka, Japan Info: http://visionsociety.jp/apcv2019/
Aug 6	CMG 2019 ChromaZone® Minneapolis, Sherwin Williams, Minneapolis, Minnesota Info: https://colormarketing.org/event/chromazone-minneapolis/
Aug 8-10	Illumination Engineering Society Annual Conference, Omni Louisville Hotel, Louisville, Kentucky Info: https://www.ies.org/events/annual-conference/
Aug 14-16	From peripheral to transsaccadic and foveal perception workshop, Castle Rauischholzhausen, Germany Info: https://www.uni-marburg.de/en/fb04/team-schuetz/ptfp
Aug 21-24	Visual Science of Art Conference, Leuven, Belgium Info: https://www.vsac2019.org
Sep 2-9	18th International Conference on Computer Analysis of Images and Patterns, Salerno, Italy Info: http://caip2019.unisa.it
Sept 19-20	ACM Symposium on Applied Perception, Barcelona, Spain. Info: https://sap.acm.org/2019/
Sept 25-28	XII Spanish Color Conference, Linares, Spain Info: https://www.uni-marburg.de/en/fb04/team-schuetz/ptfp
Oct 7-9	14th International Symposium on Visual Computing, Harrah's Lake Tahoe Hotel & Casino, Lake Tahoe, Nevada. Info: http://www.isvc.net
Oct 14-17	AIC Interim Meeting on Color and Landscape, Buenos Aires, Argentina Info: http://aic2019.org/
Oct 21-25	CIC27, Paris, France Info: http://www.imaging.org/site/IST/IST/Conferences/CIC/CIC_Home.aspx
Oct 28-31	CORM 2019 Annual Technical Conference and 12th Joint USNC/CIE and CNC/CIE - NRC, Ottawa, Canada Info: Joanne.zwinkels@nrc-cnrc.gc.ca
Nov 15-17	International Summit Color Marketing Group Info: https://colormarketing.org/event/international-summit/

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 suopport the ISCC in this way, please contact the office for more information about member benefits.

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