



IS&T REPORTER

"THE WINDOW ON IMAGING"

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SELECTED CONFERENCE ABSTRACTS: CIC17

Winner of the MERL Best Student Paper

The tangiBook: A Tangible Display System for Direct Interaction with Virtual Surfaces

*Benjamin A. Darling and James A. Ferwerda,
Rochester Institute of Technology (USA)*

Abstract: In this paper we introduce the tangiBook, a tangible display system that allows realistic simulation and direct interaction with virtual surfaces. The tangiBook is based on an off-the-shelf laptop computer that incorporates an accelerometer and a webcam as standard equipment. Custom software allows the orientation of the laptop screen and the position of the observer to be tracked in real-time. Using this information, realistic images of surfaces with complex textures and material properties, illuminated by environment-mapped lighting, are rendered to the screen at interactive rates. Tilting the laptop or moving in front of the screen produces realistic changes in surface lighting and material appearance. Thus the tangiBook allows virtual surfaces to be observed and manipulated as naturally as real ones, with the added benefit that the material properties of the surfaces can be changed in real-time. We demonstrate the potential utility of the tangiBook in three application areas: material perception research, computer-aided appearance design, and enhanced access to collections in digital libraries and museums. With its unique capabilities and commodity roots, the tangiBook can be broadly deployed and should be useful in a wide range of applications.

CIC17 Cactus Award Winner for Best Interactive Paper

In Situ Measured Spectral Radiation of Natural Objects

Dietmar Wueller; Image Engineering (Germany)

Abstract: The only commonly known source for some in situ measured spectral radiances is ISO 17321-1. It describes the principle of how the color characterization of a digital camera works and provides spectral radiances for 14 common objects.

This paper summarizes the results of a project that was started to collect several hundred measurements of all different kinds of objects under various illuminations keeping in mind typical scenes and objects that people take photographs of. In many cases the spectral radiation of objects is not only that of the reflected light. Sometimes the light coming from objects like leaves for example is a mixture of the reflected and the transmitted light. In other cases inter reflections between the objects modify the spectral radiance in scenes and some objects like the human skin appears totally different in real live compared to the skin tones of a reflective color target.

The collected data can be used as a scientific data basis for different studies related to natural objects. But the main reason to collect the data was to provide training data for the color characterization of digital cameras. Future work will show whether a carefully collected subset of the database is sufficient to create an ideal matrix or look up table for a digital camera but for the time being all app. 2500 measurements are available and used to calculate camera matrices.

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To view full papers go to
www.imaging.org/ist/publications/reporter/index.cfm

* These papers were presented at CIC17, held November 9-13, 2009, in Albuquerque, New Mexico.

Almage Quality Measures for Evaluating Gamut Mapping

Zofia Baranczuk and Peter Zolliker, Swiss Federal Laboratory for Materials Testing and Research (Switzerland), and Joachim Giesen, Friedrich-Schiller-Universität Jena (Germany)

Abstract: In this paper we compare different image quality measures for the gamut mapping problem, and validate them using psychovisual data from four recent gamut mapping studies. The psychovisual data are choice data of the form: given an original image and two images obtained by applying different gamut mapping algorithms, an observer chooses the one that reproduces the original image better in his/her opinion. The scoring function used to validate the quality measures is the hit rate, *i.e.*, the percentage of correct choice predictions on data from the psycho-visual tests. We also propose a new image quality measure based on the difference in color and local contrast. This measure compares well to the measures from the literature on our psycho-visual data. Some of these measures predict the observer's preferences equally well as scaling methods like Thurstone's method or conjoint analysis that are used to evaluate the psycho-visual tests. This is remarkable in the sense that the scaling methods are based on the experimental data, whereas the quality measures are independent of this data.

How to Make Life More Colorful: From Image Quality to Atmosphere Experience

Ingrid M.L.C. Vogels, Philips Research Europe (Netherlands)

Abstract: Image quality and color appearance have been extensively studied in the past decades, which has resulted in high quality displays. Although research on image quality is still ongoing, most improvements have only marginal effects. A new trend in display technology is emerging that focuses on enhancing the overall visual experience of the user. Two features that have been proven to be effective are the introduction of stereoscopic depth and dynamic surround light. In order to further enhance the user's experience, the atmosphere of the entire room could be adapted to the emotional content of the video. This paper gives a brief overview of research from image quality to the emotional impact of light emitting devices and identifies the research challenges for creating colorful and appealing experiences.

Ghosting Reflection Compensation Dynamic Range Imaging

Johannes Brauers and Til Aach, RWTH Aachen University (Germany)

Abstract: A compact overall design of a multispectral camera can be achieved by placing the bandpass filters between the lens and sensor. However, internal reflections between the sensor (or IR cut filter) and the optical filters may lead to weak duplicate images which impair the image quality. The duplicates called ghosting are especially noticeable near bright image regions and interfere with the surrounding image content. When using combined high dynamic range (HDR) and multispectral imaging, the increased dynamic range is of reduced value due to the ghosting.

In the current paper, we model the ghosting effect and present a calibration setup for the characterization of the ghosting, which utilizes a backlit film calibration pattern. We perform HDR imaging to acquire the vast dynamic range of the backlit scene. Our calibration algorithm then estimates the model parameters and allows a compensation of the ghosting. As long as the lens parameters are not changed, the calibration may be used for all subsequent images. We give detailed results for the calibration and the effect of the compensation.

Effects of Image Dynamic Range on Apparent Surface Gloss

Jonathan B. Phillips, James A. Ferwerda, and Stefan Luka, Rochester Institute of Technology (USA)

Abstract: In this paper we present results from an experiment designed to investigate the effects of image dynamic range on apparent surface gloss. Using a high dynamic range display, we present high dynamic range (HDR) and standard dynamic range (tone mapped, SDR) renderings of glossy objects in pairs and ask subjects to choose the glossier object. We analyze the results of the experiments using Thurstonian scaling, and derive common scales of perceived gloss for the objects depicted in both the HDR and SDR images. To investigate the effects of geometric complexity, we use both simple and complex objects. To investigate the effects of environmental illumination, we use both a simple area light source and a captured, real-world illumination map. Our findings are 1) that limiting image dynamic range does change the apparent gloss of surfaces depicted in the images, and that objects shown in SDR images are perceived to have lower gloss than objects shown in HDR images; 2) that gloss differences are less discriminable in SDR images than in HDR images; and 3) that surface geometry and environmental illumination modulate these effects. ▲

Color and Movies / Color and Light Highlight CIC17

by Francisco Imai and Erno Langendijk, CIC17 Technical Program Chairs

CIC17, the 17th Color Imaging Conference was held in Albuquerque, New Mexico, November 9-13, 2009. The three-day technical program included 3 keynotes, 32 oral presentations, and 23 interactive papers, as well as two exciting panel discussions. Conference Chairs Karen Braun (Xerox Corp.) and Moshe Ben-Chorin (Genoa Color Technologies) hosted 170 participants from around the world. The technical program was preceded by two days of short courses.

Keynotes Look Toward Future

Interesting keynote talks set the tone for each day. Wednesday, Nathan Moroney (HP Labs) gave a talk titled "Color Science & Imaging: Future Opportunities" raising questions, then answering each with current trends in color science and imaging such as the ubiquitousness of digital cameras, the progressive decrease in the ink jet drop volumes enabling prototype flexible displays, the use of spectrophotometers in large format printers, the potential of nano-scale structure colorants and variable data textiles, the increasing speed of color ink jet press, and non-photorealistic rendering.

Ingrid M.L.C. Vogels (Philips Research Laboratories) kicked off Thursday with "How to Make Life More Colorful: From Image Quality to Atmosphere Experience," in which she described recent ad-

vances in the perceptual aspects of illumination. She described the use fluorescent lamps and LED to create ambient light around a TV set, and the impact of this additional background light on the viewer. A system for analyzing the impact of such illumination was then discussed. Then, she moved to describe the role of illumination in creating varying atmosphere.

On the last day, attendees were asked to confront the "The Challenge of Our Known Unknowns" by Robert Hunt (consultant). During the talk, Hunt discussed many open questions in color theory and imaging. Some of these issues include the difference between color matching function obtained by Maxwell and maximum saturation methods, why are sharpened color matching functions used for adaptation, the inhibition of rods at high levels of illumination, and many others.

Oral Papers Program

Extreme Color, chaired by Brian Funt (Simon Fraser Univ.)

Discussing "Reflectance, Illumination and Edges," John McCann (consultant) described how he and his co-authors constructed a pair of 3D color Mondrian scenes, one lit diffusely and the other via very strong directional illumination. They measured the color appearance of the colored patches via magnitude estimation ex-

CIC17 (2009) STATISTICS

Attendees:	155
Oral Papers:	32
Interactive Papers:	23
Short Courses:	15
Dates:	November 9-13, 2009
Location:	Albuquerque, NM



Conference Chairs Karen Braun (Xerox Corp.) and Moshe Ben-Chorin (Genoa Color Technologies).

periments and in terms of the colors used in an artist's rendering of the scene. Based on results, they argue against models that discount illumination to predict color appearance.

Rodney Heckaman (RIT) presented an analysis of the range of luminance and chromaticity found in the approximately 100 HDR scenes that Mark Fairchild had previously recorded *continued on page 5*



Above: Dragan Sekulovski and Jim Ferwerda review a talk at the Speaker's breakfast. Right: The Albuquerque Museum of Art hosted the Wednesday evening Conference Reception.



STANDARDS UPDATE:

David Q. McDowell, Editor

This issue of the Standards Update includes an ISO press release concerning three recently published TC 130 (Graphic technology) and TC 42 (Photography) standards. While we have reported on these standards throughout their development, this press release puts an international perspective on their importance.

Also included are announcements about two upcoming CIE conferences.

ISO standard weathers test of time: "ISO 5" continues to deliver after 30 years (released December 16, 2009)

One of ISO's oldest International Standards has once again been fully updated in the light of the latest technological innovations and market requirements. ISO 5:2009, Photography and graphic technology – Density measurements, is the latest edition of one of the many original ISO standards which more than 30 years after publication are still having an impact today.

As its number indicates, ISO 5 was the fifth standard to be developed by ISO and is one of the oldest still actively updated and maintained. All ISO standards are periodically reviewed no later than three years after publication, and then every five years. Voting amongst ISO members decides whether an International Standard will be confirmed, revised, or withdrawn. This ensures that all active ISO standards are on par with technology and market needs.

ISO 5 is a well known multi-part standard referenced in technical specifications for photography, graphic arts, paint, paper, image permanence and radiography among others. It consists of four parts:

- Part 1: Geometry and functional notation
- Part 2: Geometric conditions for transmittance density
- Part 3: Spectral conditions
- Part 4: Geometric conditions for reflection density.

"To meet the industry's latest trends, this revision enables the use of modern

spectrally based instruments, while preserving the validity of traditional filter based instruments for measuring density. At the same time, it ensures compatibility of results using both types of instruments," says David McDowell, convenor of the working group, which prepared this revision (ISO/TC 42 JWG 21).

For the first time, all four parts were revised in concert to achieve a new level of consistency in terminology and requirements. Moreover, the review was carried out by many of the same experts working on two other key photography/graphic technology standards:

- ISO 3664:2009, *Graphic technology and photography – Viewing conditions*
- ISO 13655, *Graphic technology – Spectral measurement and colorimetric computation for graphic arts images*

ISO 5, ISO 3664 and ISO 13655 form the basis for viewing, metrology, color management and process control within the graphic technology and photographic industries.

"The joint effort to tackle the three standards in parallel has ensured a degree of compatibility among the documents that had never existed before," says McDowell. "Our greatest achievement is perhaps the unique level of cooperation established among the different technical committees involved in this work (while ISO 5 and ISO 3664 are the responsibility of ISO/TC 42, Photography, ISO 13655 is under the care of ISO/TC 130, Graphic technology)."

"Both technical committees are proud of this effort which symbolizes ISO's spirit towards international harmonization at all levels, and marks a significant milestone in the work of both committees," says McDowell.

ISO 5:2009, ISO 3664:2009 and ISO 13655:2009 are all available from ISO national member institutes. They may also be obtained directly from the ISO Central Secretariat, through the ISO Store (www.iso.org/iso/store.htm).

CIE Tutorial and Expert Symposium on Spectral and Imaging Methods for Photometry and Radiometry

30 – 31 August 2010, Bern, Switzerland—

The field of lighting is currently undergoing many historical changes. Solid state lighting is replacing classical lighting products, and these new devices require advanced characterization and measurement methods.

The International Commission on Illumination (CIE) offers a one day tutorial on state-of-the-art techniques in the field of photometry. Invited experts will present talks on basic concepts and recent advances in photometric measurement techniques. On the following day, a scientific symposium will feature contributed papers.

The event is organized by CIE Division 2 in cooperation with the Swiss Lighting Society (SLG), and is hosted by the Federal Office of Metrology (METAS). It will be held in conjunction with the annual meeting of CIE Division 2 and its technical committees.

This meeting is open to everyone with an interest in any aspect of the measurement of visible radiation and color – photometry, radiometry, and colorimetry. Early registration is recommended to ensure adequate space and support, and to allow adequate distribution and review of relevant documents.

Authors are invited to submit two-page extended abstracts of their proposed contributions, in English, no later than 30 April 2010, by e-mail to d2symp@cie.co.at.

The registration information, templates and on-line registration form will be available on the symposium website www.d2symp.ch Check also the CIE Div.2 website (<http://div2.cie.co.at>) for further announcements and updates.

When Appearance meets Lighting

The Second CIE Expert Symposium on Appearance will be held in Gent, Belgium,

September 8–10, 2010, in the auditorium of Catholic University College St.-Lieven. The symposium is for those concerned with the measurement aspects of visual appearance and the understanding of the human factors of lighting. It will allow experts to:

- present the state of the art in our understanding of the perception of colour and gloss, and.
- explore the possible applications of visual appearance knowledge to several aspects of lighting design and comfort.

Visual assessment of the appearance of objects and materials is a very complicated process and four research areas have been suggested: color, gloss, texture, and translucency. Much work has been done to

quantify color appearance, but there is still much to understand about the perception of gloss, while the elaboration of visual correlates of texture and translucency is in its infancy.

Lighting designers pay increasing attention to lighting comfort, which must at least partly be determined by the spatial distribution of the color and brightness attributed for example, to walls, ceiling, and furniture.

Appearance scientists, especially those interested in color and gloss, could offer input to those attempting to describe lighting comfort and it is clear that both research fields could benefit from a multidisciplinary approach.

This CIE Expert Symposium organized by TC 1-72 Measurement of Appearance

Network aims to create a symbiosis between both research fields, bridging the gap between color, color harmony and color emotion; between gloss, lightness, brightness and glare; and between CIE Division 1 Vision and Color and CIE Division 3 Interior Environment and Lighting Design.

Authors are invited to submit an extended abstract of their proposed contribution to the Chair of the Technical Program of the Symposium Michael Pointer (mike.pointer@btinternet.com) no later than April 30, 2010. The meeting website is <http://www.cie2010gent.be>.

For suggestions for (or input to) future updates, or standards questions in general, please contact the author at mcdowell@npes.org or mcdowell@kodak.com

continued from page 3

in his photographic survey. They found average contrast ratios of 3 orders of magnitude and maximum ratios as high as 6, and colors that came close to filling the CIE chromaticity space.

In the final paper, “A Method for Designing and Assessing Sensors for Chromaticity Constancy in High Dynamic Range Scenes” Sivalogeswaran Ratnasingam (Univ. of Oxford) explained that to provide illumination independence of surface color, he and his authors introduce a fourth narrow-band sensor class. Appropriate combination of the log of the four sensor outputs yields two features that can be used to distinguish colors independent of the color of the incident illumination.

Color Image Quality, chaired by Nathan Moroney

Zofia Baranczuk (EMPA) began with a paper on metrics for gamut mapping and noted the promising results achieved with the Structural Similarity Index or SSIM. Next, a presentation by Zhaohui Wang (Gjøvik Univ. College) compared an adaptive bilateral filter-based image difference metric with sCIELAB and iCAM. The third paper by Wei-Chung Cheng (US FDA) explored the use of electroen-

cephalography or EEG for the evaluation of artifacts of field sequential displays. Finally, Keita Hirai (Chiba Univ.) proposed and evaluated a spatial-velocity contrast sensitivity function.

Color and Movies, chaired by Lars Borg (Adobe Systems)

The session began with a focal presentation on “Optimizing Anaglyph Colors” in which Thor Olson (Electronics for Imaging) proposed how to avoid visual artifacts such as retinal rivalry and stereo cross talk while maximizing perceived color fidelity in anaglyph presentations.

In “Description and Evaluation of the Variability of the Human Color Vision in an Anti-Piracy Context,” Laurent Blondé (Thomson R&D) discussed how to cope with observer variations when using multi-spectral, metameric encoding for anti-piracy. In “From Contrast Sensitivity Function Construction to Visual Weightings Computation for Digital Cinema,” Mohamed-Chaker Larabi (Univ. of Poitiers) proposed an optimization of the JPEG2000 image compression quality for digital cinema.



Color and Movies was one of two panel discussions held at CIC17. There was also a session that further explored the topic.

Color and Light, chaired by Jim Ferwerda (RIT)

This session included three papers that integrated color imaging and illumination technologies. In the paper “Creation and Rendering of Stochastic Dynamic Light Effects,” Dragan Sekulovski (Philips Research Laboratories) described an algorithm for learning the color states and transitions in videos of natural scenes and using this information to renderer dynamic light effects in a room.

Shoji Tominaga (Chiba Univ.) then presented the paper “Spectral Imaging with a Programmable Light Source” that described a device that integrates a broadband illumination, diffraction grating, and DMD to create an agile light source for spectral imaging.

The final paper of the session, presented by Karen Braun, described a

technique for producing watermarks for print security that are invisible under typical illumination sources but become detectable under narrow-band illuminants.

Spectral Color, chaired by Norimichi Tsumura (Chiba Univ.)

Philipp Urban (Technische Univ. Darmstadt) described the investigation of parametric colors under the assumption that they follow a normal distribution with the reference color as expectation value. Hiroaki Kotera (Kotera Imaging Lab.) proposed “Spectral Imaging Model by XYZ+K Four-Band Filter” where the additional filter K was designed to rescue the “metameric black” and restores the spectral reflectance in combination with “fundamental” captured by XYZ colorimetric tri-color filters.

Mathieu Hébert (EPFL) described the prediction of the transmittance using a model inspired by the Yule-Nielsen modified spectral Neugebauer model used for reflectance predictions. The model worked well for semi-opaque printing supports and duplex prints.

Printing and Color, chaired by Patrick Emmel (Clariant International Ltd.)

Nicolas Bonnier (Océ Print Logic Technologies) presented his work on evaluating the use of the perceptual reference medium gamut in ICC describing the evaluation of the effect of using the perceptual reference medium of printed images, based on a series of psychophysical experiments conducted with a large set of sRGB images. In “Nominal scaling of print sub-

strates,” Nathan Moroney presented specific measurement data for a collection of digital commercial print substrates, exploring the correlation of these measurements and their general distribution using linguistic analysis to determine multivariate clustering by keywords.

Color Enhancement, chaired by John McCann (consultant)

The focal paper “Combining Visible and Near-infrared Images for Realistic Skin Smoothing,” by Clement Fredembach (EPFL), described the development of a framework that consists of capturing a pair of visible and near-infrared images and separating them into base and detail layers with fast bilateral filtering, showing that a smooth realistic output image can be obtained by fusing the base layer of the visible image with the near-infrared detail layer. This outperformed the equivalent decomposition in the wavelet domain.

In “Improved Color Reproduction by Hue Preservation in Integrated Multi-scale Retinex” Wang-Jun Kyung (Kyungpook National Univ.) proposed an integrated multi-scale retinex method in CIELAB to preserve hue, and obtain high contrast and naturalness, while reducing color distortion. Wei-Chun Cheng (US FDA) gave a paper that showed solutions for the color changes in cholesteric liquid crystal from voltage-induced color shift and viewing angle-dependency.



Hiroaki Kotera, Spectral Color Session Chair Norimichi Tsumura, and Mathieu Hébert review the timing of their session.

Photo: Francisco Imai

Color Manipulation, chaired by Jon Y. Hardeberg (Gjøvik Univ. College).

In a focal presentation, Benjamin A. Darling (RIT) showed us how to interactively manipulate the colors of images displayed on a laptop computer with regards to viewing direction. He guided us through the proposed novel approach as described in their paper “The tangiBook: A Tangible Display System for Direct Interaction with Virtual Surfaces.” He then gave an impressive live demonstration of the system; a risky undertaking which most probably was one of the reasons he won the MERL Best Student Paper Award.

Hamid Reza Vaezi Joze (Simon Fraser Univ.) then presented the paper “Sharpening from Shadows: Sensor Transforms for Removing Shadows Using a Single Image” in which the colors of shadow regions in images are manipulated to the extent of actually removing the shadows. The next paper, “Shaped Local Regression and its Application to Color Transforms” was presented by Victor Klassen (Xerox Corp.), standing in for the paper’s authors, his colleagues at Xerox, who unfortunately

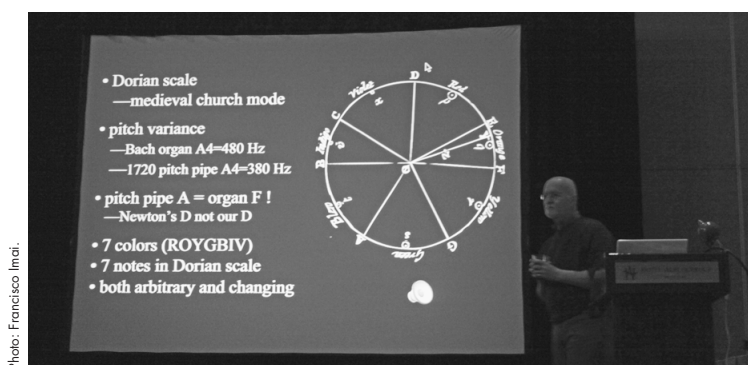


Photo: Francisco Imai

The Thursday Evening Lecture on Color and Music by Brian Evans (above), University of Alabama, was followed by an impromptu concert by Francisco Imai (right).



Photo courtesy of Francisco Imai

were not able to attend the conference. The color manipulation of this paper is more commonly known as color transformation, and the authors demonstrate the benefits of applying a powerful mathematical method to the problem of colorimetric characterization of printers.

Concluding the session, Graham D. Finlayson (Univ. of East Anglia) presented “A Unified Approach to Colour2grey and Image Enhancement Through Gradient Field Integration,” in which the authors propose a new method to perform the ultimate manipulation of image colors, namely to remove them altogether. The good thing is that doing so leaves us with very good looking enhanced grayscale images.

Late Breaking News, chaired by Francisco Imai (Canon Development Americas, Inc.) and Erno Langendijk (Philips Research Laboratories)

The first of four presentations was given by Pavel Kisilev (HP Labs Israel) who proposed a unified approach for problems of computing color transforms, such as shadow removal, object recoloring, and scene relighting using Bayesian classifiers and linear programming. M. James Shyu (Chinese Cultural Univ.) gave a presentation that introduced a model for high dynamic range image reproduction performing equivalence of perceived visual contrast for every pixel by a relative perceived visual contrast function. Alexander Forsythe (Academy of Motion Picture Arts and Sciences) presented on considerations in the design of a new printing density metric and encoding for contemporary motion picture applications that proposes a new, well-defined film printing density metric for contemporary motion picture applications. Finally, Michal Aharon (HP Labs Israel) presented her work the “Estimation of Spectral Reflectance from Densitometric Measurements Using Printing Model Prior.” The paper describes a method to use characterization of printer output to achieve accurate estimation of spectral reflectance from only three-channel measurements, such as provided by standard densitometers.



New at CIC17: Two Panel Sessions

The Color and Movies panel—moderated by Joshua Pines (Technicolor)—began with a brief presentation by the moderator and each panelist, followed by a question-and-answer period with the audience. Pines gave an introductory talk on the Technicolor technology evolution. Joseph Goldstone (Lilliputian Pictures LLC) talked about the Academy of Motion Picture Arts and Sciences’s “image interchange format” project and how that deals directly with color issues throughout the motion picture post-production pipeline.

David Stump (ASC) reported about his experience as a cameraman and about a Round Robin with several high-end digital studio cameras and a comparison to conventional film cameras. Rod Bogart (Pixar Animation Studios) talked about color as it pertains specifically to animation and stressed that both animation, as well as real world film, do not try to reproduce the real world. Louis Levinson (Laser Pacific/Kodak) talked about color correction for motion pictures and stressed that many people influence the color correction in a movie, that they all have different opinions, and speak a different language when talking color. Gary Demos (Image Essence) discussed the future of color in Hollywood and touched on 10-bit color and beyond, and the OpenEXR format for high-dynamic range recording.

Following the Color Enhancement paper session on Friday morning, a Color Enhancement Panel completed the morning



IS&T 2009 Awards presented at CIC17 included Fellowships to Yeong-Ho Ha, Kyungpook National University in Korea (top left), and Gabriel Marcu (above), Apple Inc., and the Chester F. Carlson Award to Santokh S. Badesha (left), Xerox Corp. The awards were presented by Executive VP Robert Buckley, Xerox Corp.

technical sessions. The six-member panel was moderated by Louis D. Silverstein (VCD Sciences, Inc.) and co-organized by Silverstein and Langendijk.

Silverstein began with an overview of the rationale, methodologies, and major issues associated with enhancement of the color gamut of displays. He was followed by Moshe Ben-Chorin who espoused the virtues of multi-primary displays and discussed various aspects of using more than three color primaries to enhance display color gamuts. Michael Brill (Datacolor Inc.) then gave an interesting presentation on the perils and mitigations for enhanced-gamut displays. Brill focused on the problems of on-screen metamerism when synthesizing display colors with more than three primaries and also discussed profiling and color-management issues associated with narrow-band primaries.

Mark Fairchild (RIT), always an informative and entertaining speaker, introduced several important topics including the use and abuse of extended color gamuts, observer metamerism and its relation to color primary selection, and the impact of the white point on perceived

Photos: Francisco Imai

color gamut. Langendijk then provided an insightful comparison between the viewing environments and color requirements for cinema and television and linked these ideas to the current state-of-the-art in wide-gamut display technology for television. Jan Morovic (Hewlett-Packard Española SL) concluded the presentations with a fascinating glimpse at color enhancement for today's color printing technology and discussed the importance of content- and application-dependent image and color enhancement. The presentations were followed by an interesting and lively question- and-answer period which facilitated an interactive discussion with the audience.

Interactive Session

Twenty-three Interactive papers were given at CIC17. Each was initially presented at a two-minute preview, followed by the Interactive Session. The Cactus Award for Best Interactive Paper was given to "In situ Measured Spectral Radiation of Natural Objects" to Dietmar Wueller (Image Engineering). This paper describes a database of real objects measured under real light sources and shows examples of how this

data can be used and differences compared to a simple reflective target. The first runner-up for the Cactus Award was "LED Illumination: The Future of Image Appraisal" by Michael Gall and Eric Dalton (JUST Normlicht) and the second runner-up was "Real Reproducing of 3D appearance with Multi-projectors and Cameras" by Sayuri Kamimigaki¹, Shoji Yamamoto², Keita Hirai¹, Norimichi Tsumura¹, Toshiya Nakaguchi¹, and Yoichi Miyake³ (¹Chiba Univ., ²Tokyo Metropolitan College of Industrial Technology, and ³Research Center for Frontier Medical Engineering).

Musical Evening

CIC17 featured a very entertaining lecture on Thursday evening by Brian Evans (Alabama Univ.) on "Visual Music: Seeing Sound, Hearing Color" that showed the potentials of mapping music to color images using some of his own compositions complete with compelling visuals.

CIC18: November 2010

CIC17 reaffirmed that the Color Imaging Conferences are a great place to develop



Photo courtesy of Francisco Imai.

CIC17 Technical Program Chairs Francisco Imai (far left) and Erno Langendijk (far right), seen here with Robert Hunt, have already begun planning for next year's CIC.

new ideas and meet fellow color researchers and engineers. All papers from the conference are available from IS&T as either a hardcopy proceedings book and CD or as downloadable PDFs; the latter are free to IS&T members.

The next color imaging conference (CIC18) will be held in San Antonio, Texas. General Conference Chairs Francisco Imai and Erno Langendijk, and Technical Program Chairs James Ferwerda and Geoff Woolfe (Canon Information Systems Research Australia) are hard at work on the November program. ▲

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IS&T publishes the *Journal of Imaging Science & Technology* and (with SPIE) *Journal of Electronic Imaging*.

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UPCOMING IS&T EVENTS

June 1–4, 2010; Den Haag, The Netherlands

Archiving 2010

General Chairs: Simon Tanner and Astrid Verheusen

June 14–17, 2010; Joensuu, Finland

CGIV 2010: 5th European Conf. on Colour in Graphics, Imaging, and Vision

General Chairs: Jussi Parkkinen and Timo Jääskeläinen

September 19–23, 2010; Austin, Texas

NIP26: 26th International Conference on Digital Printing Technologies/ Digital Fabrication Processes 2010

General Chairs: Gerhard Bartschar (NIP26) and Reinhard Baumann (DF2010)

November 8–12, 2010; San Antonio, Texas

Eighteenth Color Imaging Conference (CIC18)

General Chairs: Francisco Imai and Erno Langendijk

January 23–27, 2011; San Francisco Airport Hyatt Regency

Electronic Imaging 2011

Symposium Chairs: Sabine Süsstrunk and Majid Rabanni

To learn about all upcoming IS&T meetings, go to
www.imaging.org/ist/Conferences/.

For a complete list of imaging-related meetings, go to
www.imaging.org/ist/conferences/events.cfm