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Fifteenth Color Imaging Conference

Color Science and Engineering
Systems, Technologies, and Applications

November 5–9, 2007

Albuquerque, New Mexico

Sponsored by

Society for Imaging Science and Technology and
Society for Information Display



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PRELIMINARY PROGRAM

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CIC15 PROCEEDINGS

In response to attendee comments, this year CIC will print the full proceedings in color. In addition, each book will contain a CD with full-length copies of each paper. As such, you will notice an increase in registration fees, most of which is attributable to this decision. All tutorial fees remain the same as last year; in addition, this year we are offering 2- and 4-hour tutorials to students for \$50.

Bios for keynote speakers, along with their abstracts, and the abstracts of all papers being presented at CIC15 can be found at www.imaging.org/conferences/CIC15 under the technical program link.

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Conference Overview

It is our pleasure to welcome you to the first IS&T/SID Color Imaging Conference to be held in Albuquerque, New Mexico! The conference's technical program committee has put together a strong set of papers presenting the latest in the use of color in medical imaging, spatial color gamut mapping, gamut computation, color correction, high dynamic range imaging, spectral imaging, mobile displays, color appearance and other stimulating topics. As always, the conference will feature a single-track oral presentation format, complemented by an interactive paper session where participants explore topics in-depth with authors. The meeting will conclude with a Late-Breaking News session featuring recent breakthroughs in color imaging.

This year we are pleased to bring to you keynote presentations by three outstanding speakers:

- Terry Regier, associate professor in the University of Chicago's Department of Psychology, will speak on color naming and the effect of language on perception.
- Scott Tyo, associate professor of Optical Sciences and of Electrical and Computer Engineering at the University of Arizona, will give a talk about combining hyper-spectral and polarization contrast images into a unified color image.
- Fred Schubert, Wellfleet Senior Constellation Professor at Rensselaer Polytechnic Institute, will tell us about LEDs in color imaging.

In addition, we are delighted to have as our evening speaker David Haaland, senior scientist at the Cancer Biology Research Program at Sandia National Laboratories, who will present "Hyperspectral Imaging: Converting Colors to Molecular Information."

These speakers are all working in areas adjacent to the core of what CIC covers and we expect great opportunities for cross-fertilization as a result.

Again this year an extensive tutorial program precedes the conference and we are pleased to welcome back Dr. Robert Hunt to give his popular two-day course on Basic Color Science and Imaging. In addition, a day-long program of tutorials is being given on a wide range of topics, several of which are being offered for the first time. Be sure to browse through the tutorial descriptions in this booklet and check out the special rates for students and attendees of multiple tutorials.

We recognize that one of the most valuable aspects of being at the conference lies in the informal interactions amongst colleagues in the field. Thus we have planned an agenda with ample time for networking. The new conference venue, the Hotel Albuquerque at Old Town, promises to be highly conducive in this respect.

So mark your calendar for what promises to be another stimulating week of color imaging. Use the enclosed forms to submit your registration and hotel reservations now! Finally, please take a moment to share this information with friends and colleagues, particularly those who have not had the opportunity to attend this unique conference. We look forward to seeing you in Albuquerque in November!

Conference At-a-Glance

Registration will take place in the North East Atrium

Monday, November 5

Registration open 7:00 am to 4:30 pm

- Hunt two-day tutorial

Tuesday, November 6

Registration open 7:00 am to 6:00 pm

- Tutorials Program
- Hunt two-day tutorial continues
- Welcome Reception

Wednesday, November 7

Registration open 7:00 am to 5:45 pm

- Keynote: Language and Color Perception: Which Side are You on, Anyway?
- Technical Sessions:
 - New Topics
 - Capturing Color
 - Processing Color
 - Interactive Spotlight Session I
 - Displaying Color
- Conference Reception

Thursday, November 8

Registration open 7:30 am to 3:45 pm

- Keynote: Displaying Advanced Optical Imagery Information for Human Observers
- IS&T Honors and Awards Presentations
- Technical Sessions:
 - Spectral Color
 - Interactive Spotlight Session II
 - Gamuts Galore
- Interactive Paper Session
- Evening Lecture: Hyperspectral Imaging: Converting Colors to Molecular Information

Friday, November 9

Registration open 7:30 am to 3:30 pm

- Keynote: Light-Emitting Diodes: Looking Back 100 years and Looking Forward to the next 10 Years
- Cactus Award Presentation
- Technical Sessions:
 - Extreme Color
 - Perceiving Color
 - Late Breaking News

A New Venue: Albuquerque, New Mexico

For the first time in 15 years, CIC is moving locations!

CIC15 will take place at the lovely Hotel Albuquerque at Old Town (www.HotelABQ.com) in Albuquerque, New Mexico.

Room rates for singles/doubles are \$105/night.

Internet access is \$4.99 for five days.

The hotel is located five miles from the Albuquerque International Sunport (airport), just off Interstate 25. Walking out the back door of the conference center takes you directly into Old Town Albuquerque, a charming area of the city filled with restaurants, shops, and the Museum of Art and History (www.oldtownalbuquerque.com and www.albuquerqueoldtown.com).

There are direct flights to Albuquerque from 28 US cities, including Newark, Baltimore, Atlanta, Dallas, Houston, Los Angeles, Oakland, and Seattle. A PDF showing a map of non-stop service to Albuquerque can be found on the conference website.

Technical Program

Wednesday November 7, 2007

8:30 - 9:30 AM

KEYNOTE SESSION

Session Chairs: Ján Morovic, Hewlett-Packard Ltd.
and Charles Poynton, consultant

Welcome

Language and Color Perception: Which Side are You on, Anyway?, Terry Regier, University of Chicago (USA)

9:30 - 10:30 AM

NEW TOPICS

Session Chair: Karen Braun, Xerox Corporation

Making Color Adjustment Accessible to Non-Experts Through the Use of Language, Geoff Woolfe, Xerox Innovation Group (USA)
A New Model for Color Preference: Universality and Individuality, Yazhu Ling and Anya C. Hurlbert, Newcastle University, Newcastle upon Tyne (UK)

Substrate Fluorescence: Bane or Boon?, Raja Bala and Reiner Eschbach, Xerox Corporation; and Yonghui Zhao, Rochester Institute of Technology (USA)

11:10 AM - 12:10 PM

CAPTURING COLOR

Session Chair: Sabine Süsstrunk, EPFL

The Effect of Sensor Shape and Number on Surface Metamerism of Colour Input Devices, Peter Morovic, Hewlett-Packard Española (Spain), and Hideaki Haneishi, Chiba University and National Institute of Information and Communications Technology (Japan)
Illumination Estimation via Thin-Plate Spline Interpolation, Weihua Xiong, OmniVision (USA); Lilong Shi and Brian Funt, Simon Fraser University (Canada); and Sung-Su Kim, Byoung-Ho Kang, Sung-Duk Lee, and Chang-Yeong Kim, Samsung Advanced Institute of Technology (Korea)
High-resolution Imaging System for Omnidirectional Illuminant Estimation, Shoji Tominaga,

Chiba University; and Tsuyoshi Fukuda and Akira Kimachi, Osaka Electro-Communication University (Japan)

1:30 - 2:50 PM

PROCESSING COLOR

Session Chair: Hiroaki Kotera, Kotera Imaging Lab

A Standardized Workflow for Illumination-Invariant Image Extraction, Mark Drew, Muntaseer Salahuddin, and Alireza Fathi, Simon Fraser University (Canada)
Visualizing Diffusion Tensor Dissimilarity Using an ICA Based Perceptual Colour Metric, Mark Drew and Ghassan Hamarneh, Simon Fraser University (Canada)
Two-dimensional Color Correction: Recent Advances, Vishal Monga and Raja Bala, Xerox Corporation (USA)
Model Evaluation for Computer Graphics Renderings of Artist Paint Surfaces, Ying Chen, Roy S. Berns, and Lawrence A. Taplin, Rochester Institute of Technology (USA)

2:50 - 3:40 PM

INTERACTIVE SPOTLIGHT SESSION 1

Session Chairs: Jon Yngve Hardeberg, Gjøvik University College, and Francisco Imai, Samsung Advanced Institute of Technology

Perceiving Color

Evaluation of Colour Differences Against Different Coloured Backgrounds, Kai Man, Raymond Ho, Guihua Cui, and M. Ronnier Luo, University of Leeds (UK)
Re-measuring and Modeling Perceived Image Contrast Under Different Levels of Surround Illumination, Changmeng Liu and Mark D. Fairchild, Rochester Institute of Technology (USA)
A Study of Color Matching Method Between Monitor and Hardcopy, Tohru Sugiyama, Yoshiaki Kudo, and Youichi Takayama, Dai Nippon Printing Co, Ltd. (Japan)
Constructing Euclidean Color Spaces Based on Color Difference Formulas, Philipp Urban, Roy S. Berns, and Mitchell R. Rosen, Rochester Institute of Technology (USA)

Processing Color

Semi-Invariant Algorithm for Color to Gray and Back, Takahiko Horiuchi, Fuminori Nohara, and Shoji Tominaga, Chiba University (Japan)

Nonparametric Color Clustering in Chrominance Plane by Parzen Window (Interactive), Hiroaki Kotera, Kotera Imaging Lab (Japan)

Multispectral Image Segmentation of Paintings Drawn with Natural Mineral Pigments Using the Kernel Based Nonlinear Subspace Method, Hideaki Haneishi, Ryosuke Ohtani, and Hiroshi Kouno, Chiba University (Japan)

Maximum Entropy Spectral Models for Color Constancy, Sandra Skaff and James J. Clark, Centre for Intelligent Machines, McGill University (Canada)

Temporal Color

Measurement and Modeling of Viewing-Condition-Dependent Spatio-Velocity Contrast Sensitivity Function, Keita Hirai, Norimichi Tsumura, Toshiya Nakaguchi, and Yoichi Miyake, Chiba University (Japan)

Smoothness and Flicker Perception of Temporal Color Transitions, Dragan Sekulovski, Ingrid Vogels, Maurice van Beurden, and Ramon Clout, Philips Research Eindhoven (The Netherlands)

Discrimination and Preference of Temporal Color Transitions, Ingrid Vogels, Dragan Sekulovski, and Bartjan Rijs, Philips Research (The Netherlands)

Image Quality Modelling for Moving Streams, Jin-Seo Kim, Maeng-Sub Cho, and Bon-Ki Koo, ETRI (Republic of Korea); and M. Ronnier Luo and Steve Westland, University of Leeds (UK)

Displaying Color

Color Performance of a MVA LCD Using LED Backlight, Ruibo Lu, Xiangyi Nie, and Shin-Tson Wu, University of Central Florida (USA)

Beyond Simple Additivity: A Two Step Parametric Model For Digital Displays, Laurent Blondé and Jürgen Stauder, Thomson R&D (France)

Capturing Color

The Bright-chromagenic Algorithm for Illuminant Estimation, Clement Fredembach and Graham D. Finlayson, University of East Anglia (UK)

Automatic White Balancing via Gray Surface Identification, Weihua Xiong, OmniVision (USA); Brian Funt and Lilong Shi, Simon Fraser University (Canada); and Sung-Su Kim, Byoung-Ho Kang, Sung-Duk Lee, and Chang-Yeong Kim, Samsung Advanced Institute of Technology (Korea)

Analysis of Mean Square Errors of Recovered Spectral Reflectances by Multispectral Cameras, Noriyuki Shimano and Mikiya Hironaga, Kinki University (Japan)

4:20 - 5:40 PM

DISPLAYING COLOR

Session Chair: Joseph Goldstone, Lilliputian Pictures LLC

Mean Observer Metamerism and the Selection of Display Primaries, Mark D. Fairchild and David R. Wyble, Rochester Institute of Technology (USA)

The Influence of the Relative Luminance of the Surround on the Perceived Quality of an Image on a Large Display, Seo Young Choi, M. Ronnier Luo, and Michael R. Pointer, University of Leeds (UK)

Color Reproduction Considering the Average Picture Level and Flare Effect in PDP Displays, Oh-Seol Kwon, In-Su Jang, Tae-Yong Park, and Yeong-Ho Ha, Kyungpook National University (Korea)

Applying CIECAM02 for Mobile Display, YungKyung Park, ChangJun Li, and M. Ronnier Luo, University of Leeds (UK); and Youngshin Kwak, Du-Sik Park, and Changyeong Kim, Samsung Advanced Institute of Technology (South Korea)

Conference Reception

Thursday November 8, 2007

**8:30 - 9:30 AM
KEYNOTE SESSION**

Displaying Advanced Optical Imagery Information for Human Observers, Scott Tyo, *University of Arizona (USA)*
IS&T Honors and Awards

**9:30 AM - 11:30 PM
SPECTRAL COLOR**

Session Chair: Mitchell Rosen, Rochester Institute of Technology

Fast Spectral-Based Separation of Multispectral Images, Philipp Urban, *Hamburg University of Technology (Germany)*; and Mitchell R. Rosen and Roy S. Berns, *Rochester Institute of Technology (USA)*
Spectral Color Reproduction Using an Interim Connection Space-based Lookup Table, Shohei Tsutsumi, *Canon Inc. (Japan)*; and Mitchell R. Rosen and Roy S. Berns, *Rochester Institute of Technology (USA)*
Spectral Encoding/Decoding Using LabRGB, Fumio Nakaya and Noboru Ohta, *Fuji Xerox Company, Limited (Japan)*
Spectral Filtering for Color Discrimination Enhancement, Ken Nishino and Shigeki Nakauchi, *Toyohashi University of Technology (Japan)*; Arto Kaarna, *Lappeenranta University of Technology (Finland)*; and Kanae Miyazawa, *Itoh Optical Industrial Co., Ltd. (Japan)*

**11:30 AM - 12:10 PM
INTERACTIVE
SPOTLIGHT SESSION 2**

Session Chairs: Jon Yngve Hardeberg and Francisco Imai

Gamuts Galore

The Effect Display Gamut Volume on Image Preference, Rodney L. Heckaman and Mark D. Fairchild, *Rochester Institute of Technology (USA)*; and Masato Sakurai, Takehiro Nakatsue, and Yoshihide Shimpuku, *Sony Corporation (Japan)*
Efficient Hue-preserving and Edge-preserving Spatial Color Gamut Mapping, Øyvind Kolås and Ivar Farup, *Gjøvik University College (Norway)*

A Colour Gamut Based on Reflectance Functions, C. J. Li, C. Li, M. Ronnier Luo, and Michael Pointer, *University of Leeds (UK)*
Spectral Gamut Mapping and Gamut Concavity, Behnam Bastani, *Hewlett-Packard Company (USA)*, and Brian Funt, *Simon Fraser University (Canada)*
Color Correction by Considering the Distribution of Metamers within the Mismatch Gamut, Philipp Urban and Rolf-Rainer Grigat, *Hamburg University of Technology (Germany)*; and Roy S. Berns, *Rochester Institute of Technology (USA)*
Fast Computation of Multi Primary Color Gamuts, Ján Morovic, *Hewlett-Packard Española (Spain)*

Extreme Color

The HDR Photographic Survey, Mark D. Fairchild, *Rochester Institute of Technology (USA)*
LinLogBef File Format for HDR Image, Sergej N. Bezryadin, *KVVE International, Inc (USA)*
OECF Characterization of a Non-linear HDR Color Camera for Automotive Applications, Dirk Hertel and Edward Chang, *Sensata Technologies, Inc. (USA)*
iCAM06, HDR, and Image Appearance, Jiangtao Kuang and Mark Fairchild, *Rochester Institute of Technology (USA)*

Printing and Color

Photo-inkjet Printing Method Based on the Limited Total Amount and Dot-visibility of Six-colorant, Joong-Hyun Kim, Chang-Hwan Son, Tae-Yong Park, and Yeong-Ho Ha, *Kyungpook National University (Korea)*
Hierarchical Compression of Color Look Up Tables, Aravindh Balaji S. R. and Gaurav Sharma, *University of Rochester*; and Mark Q. Shaw and Randall Guay, *Hewlett-Packard Company (USA)*

1:30 - 2:50 PM

GAMUTS GALORE

Session Chair: Gaurav Sharma, University of Rochester

Spatial and Color Adaptive Gamut Mapping Algorithms, Nicolas Bonnier,^{1,2} Francis Schmitt,¹ Michael Hull,² and Christophe Leynadier,²

¹Ecole Nationale Supérieure des Télécommunications; ²OCE Print Logic Technologies S.A. (France)
Visually Closest Cross-Gamut Matches Between Surface Colors, Ján Morovic, Jordi Arnabat, and Jordi Vilar, Hewlett-Packard Española (Spain)

Representing an N-Dimensional Device Color Gamut, Xianfeng Zhao, Pantone, Inc. (USA)
A New Colour Gamut for Object Colours, X. Li, C. J. Li, M. Ronnier Luo, and Michael Pointer, University of Leeds (UK); and M. Cho and J. Kim, Electronic and Telecommunication Research Institute (Republic of Korea)

2:50 - 5:00 PM

INTERACTIVE PAPER SESSION

8:00 - 9:15 PM

EVENING LECTURE

Hyperspectral Imaging: Converting Colors to Molecular Information (Evening Lecture), David Haaland, Sandia Labs (USA)

Friday November 9, 2007

8:30 - 9:30 AM

KEYNOTE SESSION

Light-Emitting Diodes: Looking Back 100 Years and Looking Forward to the next 10 Years, E. Fred Schubert, Rensselaer Polytechnic Institute (USA)

Presentation of Cactus Award for “Best Interactive Paper”

9:30 - 11:50 AM

EXTREME COLOR

Session Chair: Paul M. Hubel, Foveon, Inc.

Glare-limited Appearances in HDR Images, Alessandro Rizzi and Marzia Pezzetti, Università degli Studi di Milano (Italy); and John McCann, McCann Imaging (USA)
Evaluation of HDR Tone Mapping Algorithms Using a High Dynamic Range Display to Emulate Real Scenes, Jiangtao Kuang, Rod Heckaman, and Mark Fairchild, Rochester Institute of Technology (USA)

4 FOR THE PRICE OF 3

Take advantage of our special offer!

Take any three two-hour tutorials and get the fourth free!

To do so, you must register via fax using the form on the back cover.

High Dynamic Range Astronomical Imaging, Thor Olson, Electronics for Imaging (USA)
Colors in Dim Illumination and Candlelight, John McCann, McCann Imaging (USA)
Quantifying Colour Appearance for Unrelated Colour Under Photopic and Mesopic Vision, Chenyang Fu, Changjun Li, M. Ronnier Luo, R. W. G. Hunt, and Michael R. Pointer, University of Leeds (UK)

1:30 - 2:30 PM

PERCEIVING COLOR

Session Chair: Masao Aizu, Canon, Inc.

Colour Memory Match Under Disparate Viewing Conditions, Ondrej Panak, Peter Nussbaum, and Jon Y. Hardeberg, Gjøvik University College (Norway)
Color Correction of Uncalibrated Images for the Classification of Human Skin Color, Joanna Marguier and Sabine Süsstrunk, Ecole Polytechnique Fédérale de Lausanne (Switzerland); and Nina Bhatti, Harlyn Baker, and Michael Harville, Hewlett-Packard Laboratories (USA)
Seeing Beyond Luminance: A Psychophysical Comparison of Techniques for Converting Colour Images to Greyscale, David Connah and Graham Finlayson, University of East Anglia; and Marina Bloj, University of Bradford (UK)

2:30 - 3:30 PM

LATE BREAKING NEWS

Session Chair: Graham D. Finlayson, University of East Anglia

Closing Remarks

Tutorial Program

CIC Special Two-Day Event: The Hunt Course

Monday and Tuesday, November 5 & 6, 2007

8:30 am to 5:00 pm

Basic Color Science and Imaging

An in-depth tutorial with Dr. Robert W. G. Hunt

This comprehensive two-day course will cover the principles of color perception, measurement, and reproduction, as applied to photography, television, printing, desk-top publishing, and electronic imaging. Each day will comprise six one-hour lectures with discussion.

Prerequisites: a minimum of one year of college chemistry, physics, and math is recommended and some experience with color systems is helpful, but not mandatory.

Benefits: This course will enable the attendee to:

- Describe normal color vision in terms of system components and their functions, trichromacy, adaptation, and luminance
- Discuss light sources including incandescent and fluorescent lamps, daylight, color temperature, and standard illuminants
- Understand the principles of spectrophotometry, including the geometry of illumination, and viewing and dealing with fluorescent samples
- Explain the experimental basis of colorimetry the reason why some colors cannot be matched by RGB additive mixtures
- Explain primaries, chromaticity, the effects of changing primaries, and color matching functions
- Describe the CIE system of colorimetry, including the XYZ, u' , v' , CIELUV, and CIELAB systems, and understand the concepts of whiteness, advanced color

difference formulae, observer and illuminant metamerism indices, color-inconstancy index, chromatic adaptation transform, and color appearance models

- Describe color reproduction in terms of both additive and subtractive trichromatic principles and become familiar with television display devices and color film and its processing
- Learn about densitometry and describe the factors affecting tone reproduction
- Understand the principles involved in broadcast television and digital cameras
- Discuss the application of color science to lithographic printing
- Appreciate what factors affect quality in digital imaging and desk-top publishing
- Understand the essential requisites of successful color imaging

Robert Hunt worked for 36 years at the Kodak Research Laboratories in Harrow, England, taking early retirement as Assistant Director of Research in 1982. Since then he has been working as an independent color consultant. He has had two books published: The Reproduction of Colour, now in its sixth edition, and Measuring Colour, now in its third. He has attended all the previous Color Imaging Conferences and is a regular contributor of keynote papers.

Cost before October 5th:

\$650 IS&T/SID members

\$825 non-members

\$350 student members

\$425 student non-members

add \$50 to all fees after Oct. 5

CIC Special One-Day Tutorial: Practical Applications of Measurement Systems in Color Engineering

Tuesday, November 6, 2007

8:00 am to 5:50 pm

Instructors: Danny Rich, Sun Chemical Corp., and
David R. Wyble, Rochester Institute of Technology

The engineering of color imaging systems requires both the fundamental and practical understanding of color measurement systems. When the goal of an engineering design is to optimize color reproduction, the results can only be as good as the input color measurements on which the optimization is based. This tutorial starts with a foundation of color measurement theory. From this beginning, various applications are covered, each including the instrument setup and associated measurement implications. The tutorial closes with a hands-on demonstration of several modern instruments with the focus on measurements that facilitate device profiling.

Benefits: This course will enable the attendee to:

- Identify the components of a spectrophotometer and the functions of each
- Define the calibration and standardization processes of spectrophotometers and understand the differences between each process
- Interpret measurement requirements and select appropriate measurement parameters and geometries for various applications
- Consider the implications of materials properties as they relate to color measurement
- Perform and critically review the color measurements required for device profiling
- Assess the use of instruments for the specific application of device profiling

Intended Audience: color engineers and technologists responsible for making and interpreting color measurements of all types, especially

those in color image reproduction and those who must create device profiles that produce the highest level of predictability in the communication and reproduction of colored images. An engineering background is not required, although an understanding of basic scientific principles will be very helpful.

Danny C. Rich has a BS and MS in optical physics and a PhD in color science from the Rensselaer Color Measurement Laboratory, under the direction of the late Fred W. Billmeyer, Jr. He has been published on all aspects of color science and technology and is active in color measurement standards organizations such as ASTM E12 on Color & Appearance, ISO TC130 on Graphic Arts, and in CIE Division 2 on Measurement of Optical Radiations. Rich is currently head of the Color Research Laboratory at the Sun Chemical Corp., the world's largest producer of printing inks.

David R. Wyble is a color scientist within the Munsell Color Science Laboratory at the Rochester Institute of Technology. He holds a BS in Computer Science and a MS in Color Science from RIT. Wyble currently teaches graduate color measurement at MCSL, and has taught various computational and imaging courses for the last decade at RIT. He has been published in the areas of device characterization and color instrumentation. Wyble is active in the Inter-Society Color Council and the Council of Optical Radiation Measurements.

Cost of class before October 5th:

\$300 IS&T/SID members

\$350 non-members

\$175 student members

\$200 student non-members

add \$50 to all fees after Oct. 5

The following tutorials take place on
Tuesday, November 6, 2007

TRACK 1: COLOR APPEARANCE

**T1A: Image Quality Assessment Using Ranks:
A Hands-on Experience**

10:20 am–12:20 pm (2 hours)

Instructor: J. A. Stephen Viggiano,
Rochester Institute of Technology (RIT)

Learn how to use human observations to assess image quality and get hands-on experience doing it. After a brief introduction/review of psychometric image quality assessment, the modern analysis method of rank order experiments is introduced. A hands-on experience is the focus of the tutorial and a rank order image quality experiment is conducted and analyzed using ordinary spreadsheet software. Error bars are computed and multiple range tests run, so that the stimuli may be placed into groups not statistically significantly different from each other.

Benefits: This course will enable the attendee to:

- Construct a scale of image preference from a rank-order experiment
- Establish statistical significance between different alternatives in a rank-order experiment
- Understand results reported for rank-order experiments performed by others
- Recognize the advantages of rank-order experiments over other methods
- Avoid pitfalls in older analysis methods

Intended Audience: The tutorial assumes no prior experience with psychometric-based image quality assessment, so those new to psychometrics can expect to understand the material; all that's assumed is a passing familiarity (perhaps from a previous life) of basic statistics. However, because the focus is on the hands-on activities and the review is relatively brief, even those familiar with psychometrics who wish to bring their knowledge up to date are encouraged to attend. If you're using paired

comparison and want to learn a faster and more efficient way, or if you've tried rank order in the past, but are unfamiliar with modern analysis techniques or had been wary of unreasonable assumptions (which are avoided in this modern analysis protocol), you should attend this tutorial. Scientific, engineering, and marketing personnel with technical background will all benefit from this hands-on experience.

J. A. Stephen Viggiano is Principal and Founder of Acolyte Color Research, a consulting and research firm specializing in solutions to problems in color science and technology. He is also a PhD candidate at RIT's Center for Imaging Science, with a concentration in Color Science. Between 1991 and 2001, Viggiano was a member of the faculty of RIT's College of Imaging Arts and Sciences. Until 2001, he was also employed by RIT Research Corporation, where he had risen to the position of Principal Imaging Scientist. Viggiano has taught this workshop as a part of some of his graduate-level courses at RIT, as well as for corporate and government clients.

**T1B: Spatio-chromatic Vision
Models for Imaging**

1:30–3:30 pm (2 hours)

Instructor: Jan Allebach, Purdue University

This course describes the context, structure, and applications of spatio-chromatic vision models for imaging. After a brief review of the important characteristics of the visual system and the basic concepts of color science, a general framework for spatio-chromatic vision models based on trichromacy, color opponency, and the limited spatial frequency response of the vision system is developed. Next applications of these models to color image quantization and digital color halftoning are discussed. During the last part of the course, a more complex group of models that account for the multi-channel nature of the visual system, the dependence of percept on contrast, and the role of the

psychometric function in describing detection and discrimination is introduced. Finally, potential applications of these models to image quality assessment are discussed.

Benefits: This course will enable the attendee to:

- Understand the fundamental spatio-chromatic aspects of the visual system and how they can be captured in models.
- Know how spatio-chromatic models for the human visual system can be used in the development of color image quantization and halftoning algorithms, and also for image quality assessment.

Intended Audience: scientists, engineers, analysts, and managers involved in the design, engineering, manufacturing, marketing, or evaluation of imaging products, algorithms, or systems. Participants should be familiar with the function and basic properties of color imaging systems. A rudimentary knowledge of color science, linear systems, and image processing would be helpful, but is not essential.

Jan P. Allebach received his BSEE from the University of Delaware (1972) and PhD from Princeton University (1976). He was on the faculty at the University of Delaware (1976 to 1983) and since then has been at Purdue University where he is Michael J. and Katherine R. Birck Professor of Electrical and Computer Engineering. His current research interests include image rendering, image quality, color imaging, and digital publishing. Allebach is a Fellow of the IEEE, IS&T, and SPIE. He has served as Distinguished/Visiting Lecturer, an officer, and on the Board of Directors for the IEEE Signal Processing Society and IS&T. He is a past Associate Editor for IEEE Transactions on Signal Processing and IEEE Transactions on Image Processing, and is presently editor of the Journal of Electronic Imaging. He has received the Senior (best paper) Award from the IEEE Signal Processing Society, the Bowman Award from IS&T, and was named 2004 Electronic Imaging Scientist of the Year. In 2007, he was named IS&T Honorary Member, IS&T's highest award. Allebach has also received four teaching awards at Purdue University.

TTC: Image Appearance

3:50–5:50 pm (2 hours)

Instructor: Mark Fairchild, RIT

This tutorial provides an introduction to image appearance specification and modeling as well as describing some fundamental phenomena and techniques. Concepts for extending current color appearance models such as CIECAM02 into image appearance models dealing with complex spatial and temporal interactions are discussed, including an introduction of one image appearance framework called iCAM. Digital imaging systems can benefit from accurate and efficient image appearance models to allow rendering of image data on various displays and the specification of image differences and quality.

Benefits: This course will enable the attendee to:

- Describe the extension of color appearance to image appearance
- Summarize the framework of image appearance models
- Develop, implement, and use image difference/quality metrics
- Understand HDR image/video rendering issues
- Consider future directions in color and image appearance
- Judge the utility of image appearance models in their application

Intended Audience: scientists and engineers involved in either designing or working with systems that produce or reproduce images/video in various media and/or are observed under varying viewing conditions. Knowledge of the fundamentals of colorimetry and color appearance is assumed.

Mark D. Fairchild, professor of Color Science and director of the Munsell Color Science Laboratory in the Chester F. Carlson Center for Imaging Science at the Rochester Institute of Technology (RIT), received his BS and MS in Imaging Science from RIT and PhD in Vision Science from the University of Rochester. He was chair of CIE Technical Committee 1-34 on color appearance models and is currently a member several other CIE technical com-

mittees dealing with color appearance and image technology issues. Fairchild was presented with the 1995 Bartleson Award by the Colour Group (Great Britain) and the 2002 Macbeth Award by the Inter-Society Color Council for his research work in color appearance and other areas of color science. He is author of the book, Color Appearance Models, 2nd Ed., that serves as a reference to the fundamentals of color appearance and the formulation of specific models. He served as Color Imaging Editor for the Journal of Imaging Science and Technology for three years and was named a Fellow of IS&T in 2003 for his contributions to digital color imaging.

TRACK 2: COLOR MEASUREMENT

T2A: The Digital Camera Image Processing Pipeline: From Sensor to Picture

8:00 – 10:00 am (2 hours)
Instructor: Matthew Whalen,
Applied Color Science, Inc.

This tutorial describes the image processing elements (Bayer De-mosaic, Color Matrix, Exposure Control, Gamma, White Balance, Sharpening, etc.) in a digital camera that transform raw pixel output from an image sensor into full color video or still images. The course also explains the function of each processing elements and discusses various implementations and tradeoffs for each with examples.

Benefits: This course will enable the attendee to:

- Understand the basic elements of a digital camera image processing pipeline
- Realize the differences between video and still image processing
- Appreciate the tradeoffs among image processing algorithms
- Identify image processing problems from evaluation of output images

Intended Audience: digital camera designers, imaging engineers, and managers involved or interested in developing or improving an image processing pipeline.

Tutorial Fees

Separate registraion is required.

if you register:	by Oct. 5	after Oct. 5
2-hour Member	\$150	\$180
2-hour Non-member	\$195	\$225

Special Student Rate: Full- and part-time students with official ID may register for any single 2- or 4-hour tutorial for \$50. Student rates for the one- and two-day courses are found at the end of the descriptions and on the back cover.

IS&T/SID reserves the right to cancel classes in the event of insufficient advance registration. Please indicate your interest early.

Matthew Whalen, founder and chief imaging scientist for Applied Color Science, Inc. (www.appliedcolorscience.com), has been actively involved in CMOS image sensor applications and digital image processing for more than ten years. Whalen’s work in image sensor evaluation and image processing development has ranged from consumer products (AT&T Videophone, SiliconFilm’s eFilm cartridge) to medical (Smith and Nephew HD endoscopy camera) to professional (RED digital cinema camera). Whalen has held senior technical positions with Lucent/ Bell Labs, Conexant, and SiliconFilm Technologies. He currently holds more than ten patents in the areas of lightwave and digital camera technology and has published numerous technical articles and conference papers in these areas. Whalen has a BS and MS in Physics from Rutgers University and is a member IS&T.

T2B: Electro-photographic Printing Technology

10:20 am–12:20 pm (2 hours)
Instructor: Fumio Nakaya, Fuji Xerox Company, Ltd.

The course contains a brief summary of electro-photographic printing technology followed by a description of its applications, consumer materials, and image quality design. Various types of electro-photographic printing process and corresponding subsystems are explained in detail. The topics in image quality design are optimum microscopic

image structure, how to evaluate image quality, and what optimum color reproduction would be. Printer color characterization method are described with corresponding industrial standards. The course is designed for students and engineers in printing technology and development, and in color image quality design and evaluation.

Benefits: This course will enable the attendee to:

- Summarize the current non-impact printer market
- Explain various printer configurations
- Clarify the electro photographic process
- Characterize printer color characteristics
- Develop color image quality
- Design consumer materials

Intended Audience: printer development engineers, color image quality designers, and consumer materials development engineers

Fumio Nakaya received a BS in Mechanical Engineering from Keio University (1976). Since then, he has worked in research and development at Fuji Xerox Co., Ltd. and has 30 years of working experience in electro-photographic printing, including chief engineer of corporate image-quality design team. His work has primarily focused on electro-photographic process simulation, image quality design, and color management. He is a member of IS&T, CIE, ISO, IEC, and ICC.

T2C: Optimizing Color for Display

3:50–5:50 pm (2 hours)

Instructor: Gabriel Marcu, Apple Computer, Inc.

This tutorial introduces color optimization techniques for various display types, covering LCD (transmissive, reflective and trans-reflective), plasma, OLED, and projection systems (DLP, LCD, LCoS) and ranging from mobile devices to large LCD TV screens. Factors such as technology, luminance level, dynamic/static contrast ratio, gamma correction, color gamut, viewing angle, white point, gray tracking, response time, color model, calibration, characterization are discussed and color optimization methods for displays are presented.

Benefits: Tutorial participants will be able to:

- Identify the critical color parameters for various displays from mobile devices to LCD TV
- Understand the color performances and limitations for various LCD modes (TN, IPS, MVA, FFS and OCB) used in different devices (mobile, monitor, LCD TV and projector).
- Select the optimal color model for a display and highlight its dependency on display technology
- Follow a live calibration and characterization of an LCD screen and of the projector used in the class, using tools varying from visual calibrator to instrument based ones
- Apply the knowledge from the course to practical problems of color optimization for displays

Intended Audience: engineers, scientists, managers, pre-press professionals, and others confronting display related color issues.

Gabriel Marcu is Senior Scientist in ColorSync group, at Apple Computer. His achievements are in color reproduction on displays and desktop printing (characterization/calibration, halftoning, gamut mapping, ICC profiling, HDR imaging, RAW color conversion). Marcu is responsible for color calibration and characterization of Apple display and for RAW color for digital camera in MacOS X. He has taught seminars and short courses on color topics for UC at Berkeley, IMI London (UK), and various IS&T, SPIE, and SID conferences. He was co-chair of the SPIE/IS&T Electronic Imaging Symposium in San Jose; the IS&T/SID Color Imaging Conference in Scottsdale; and EI Color Imaging: Processing, Hardcopy, and Applications. He is a SPIE Fellow.

Tutorial monitors are needed to help with classes; monitors take the class for free.

**Interested parties should contact
Felecia Marsh at
color@imaging.org.**

Priority will be given to students.

TRACK 3: COLOR SYSTEMS

T3A: Color in High Dynamic Range Imaging

8:00–10:00 am (2 hours)

Instructor: Greg Ward, Anyhere Software

The instructor describes the techniques and technologies behind high dynamic range (HDR) imaging, covering methods for HDR capture, representation, editing, and display. The tutorial features live demonstrations of HDR image capture using a standard digital camera, and image-based lighting techniques for rendering synthetic objects into a real environment. The instructor also addresses tone- and gamut-mapping issues for low dynamic range (LDR) output and printing.

Benefits: This course will enable the attendee to:

- Compare LDR to HDR imaging
- Outline basic methods for HDR image capture
- List major HDR image formats, their strengths, and weaknesses
- Describe the dual-modulation method for HDR image display
- Summarize the tone-mapping problem as it applies to HDR image printing
- Define image-based lighting and give examples from recent movies

Intended Audience: color scientists, software and hardware engineers, photographers, cinematographers, production specialists, and students interested in the means and rewards of extending the dynamic range of their pipeline. By taking the audience from the basics of HDR to more advanced techniques such as image-based lighting, we hope to convey the simplicity and power of this exciting new trend in digital imaging.

Greg Ward is a leader in the HDR space, having developed the first widely-used HDR image file format in 1986 as part of the RADIANCE lighting simulation system. Since then, he has developed the LogLuv TIFF HDR image format, the JPEG-HDR format, and authored the application Photosphere, an HDR image builder and browsing program. More recently, he has been involved with Dolby

Canada's HDR display developments, which employ dual modulators to show colors 30 times as bright and ten times as dark as conventional monitors. Working in the computer graphics research community for more than 20 years, Ward has developed rendering algorithms, reflectance models and measurement systems, tone reproduction operators, HDR image processing techniques, and photo printer calibration methods. His past employers include the Lawrence Berkeley National Laboratory, EPFL Switzerland, SGI, Shutterfly, and Exponent. Ward holds a BS in Physics from UC Berkeley and MS in Computer Science from San Francisco State University. He is currently working as a consultant in Albany, California (www.anyhere.com).

T3B: Wide Gamut Imaging

10:20 am–12:20 pm (2 hours)

Instructor: Charles Poynton, consultant

The color gamut of digital imaging systems, in both the professional and consumer domains, has historically been limited by CRT technology and by the Rec. 709 and sRGB standards. Emergent display technologies (such as LED-backlit LCDs and laser- and LED-illuminated DLPs) are poised to enable wide-gamut color, and D-SLR cameras are already capable of wide-gamut capture. This seminar outlines the technological developments in capture, processing, and display technology that are leading to wide gamut color. Various wide-gamut encoding systems such as Adobe RGB, DCI P3 RGB, X'Y'Z', xvYCC, and wcsRGB are describe in detail.

Benefits: This course will enable the attendee to:

- Summarize various deployed and proposed wide-gamut encoding systems
- Estimate gamut coverage of various capture and display technologies
- Explain the signal processing required to capture, encode, and reproduce wide-gamut scenes
- Evaluate wide-gamut color encoding systems

Intended Audience: appropriate for technical professionals who are experienced in the engineering of color imaging systems. Many graphs, equations, and diagrams will be presented.

Charles Poynton is an independent contractor specializing in the physics, mathematics, and engineering of digital color imaging systems, including digital still cameras, digital video, HDTV, and digital cinema (D-cinema). He does technology forecasting, systems modeling, algorithm development (including digital filter design), video signal processing architecture, color characterization and calibration, and image quality assessment. He is involved in engineering wide color gamut (wide colour gamut) systems, including xvYCC.

T3C: Spectral Imaging

1:30–3:30 pm (2 hours)

Instructors: Roy Berns and Mitchell Rosen, RIT

Conventional trichromatic imaging (*i.e.*, RGB) can have a wide range of colorimetric accuracy and is always constrained by metamerism. For color-critical, scientific, and archival applications, trichromatic imaging is often insufficient. Spectral imaging alleviates these limitations. This tutorial is an overview of spectral-imaging and reproduction techniques. Applications for quality-critical color reproduction (*i.e.*, spectral color reproduction) and scientific-based digital archives are explored.

Benefits: This course will enable the attendee to:

- Understand the advantages and disadvantages of spectral imaging compared with trichromatic imaging
- List and compare different techniques of spectral imaging
- Become familiar with the foundations of estimating spectral reflectance from multi-channel images
- Learn about separation techniques for spectral reproduction
- Comprehend the applications of spectral imaging for multi-ink printing, spectral color management, and scientific-based digital archiving

Intended Audience: those wishing to become more familiar with the opportunities and challenges within the emerging field of spectral color reproduction, which may include color and imaging scientists, camera and printer designers, and image processing specialists.

Roy S. Berns is the R. S. Hunter Professor of Color Science, Appearance, and Technology at the Munsell Color Science Laboratory, and graduate coordinator of the Color Science Master's program within the Center for Imaging Science at Rochester Institute of Technology (RIT). He directs a research group that has been active in spectral imaging and spectral color reproduction for nearly a decade. The group has designed spectral imaging systems for the National Gallery of Art in Washington and the Museum of Modern Art in New York. He has also collaborated with the Art Institute of Chicago and the Van Gogh Museum in using spectral-imaging concepts for "digital rejuvenation" of cultural heritage. Berns, the author of *Billmeyer and Saltzman's Principles of Color Technology*, 3rd edition, is an IS&T Fellow.

Mitchell R. Rosen is a Research Professor with the Munsell Color Science Laboratory at Rochester Institute of Technology (RIT). His recent projects have spanned subjects such as spectral and colorimetric color reproduction, color management, immersive dynamic media, digital cinema and on-demand print quality. He is Color Imaging editor of the *Journal of Imaging Science and Technology* and is active in organizing international conferences on spectral imaging. Rosen co-edited the book *Color Desktop Printer Technology*.

T3D: Vectorial Color

3:50–5:50 pm (2 hours)

Instructor: James Worthey, consultant

Use of color vectors can demystify camera sensors, lighting, and other topics, but new color matching functions (CMFs) are needed. Orthonormal opponent CMFs map lights into Jozef Cohen's logical color space and establish intuitive axes: whiteness, red-green, and blue-yellow. Color mixing is summarized by an invariant curve in 3D, the locus of unit monochromats (LUM). If a camera's LUM matches the eyes, it meets Luther's criterion. Worthey presented details at CIC 12 and 14. This tutorial emphasizes the practical use of color vectors and the orthonormal CMFs. If you are planning to bring a computer, please install a VRML viewer prior to attending the course. For

background and more information, see www.jimworthey.com.

Benefits: This course will enable the attendee to:

- Use the orthonormal CMFs and calculate color vectors
- Understand the Locus of Unit Monochromats and the role of vector amplitude
- Work with 3D plots of such data as color chips under a lighting change
- Generate a camera's orthonormal basis and compare it to the eyes. The algorithm is simple; understanding may take a little time.
- Use the camera's orthonormal basis, compare light sources; thus analyze a copier or flash camera

Intended Audience: scientists and engineers who design or apply camera systems or lights. While certain applications will be stressed, the vectorial approach applies to all color work. For example, multi-primary systems and image compression are natural applications.

James Worthey received a BS in EE, an MS in Physics, and a PhD in Physiological Optics from Indiana University. He researched lighting and color at the National Institute of Standards and Technology and published several applications of opponent colors. A breakthrough came in 2003 when he combined opponent colors with Cohen's ideas and computer graphics.

TRACK 4: COLOR MANAGEMENT

T4A: Color Management in Apple ColorSync

8:00–10:00 am (2 hours)

Instructor: Luke Wallis, Apple Computer, Inc.

This tutorial gives an overview of ColorSync, which is the foundation block of Color Management in Mac OS X. The course describes the architecture of color management in the system, along with the principles of using ColorSync, then addresses details related to acquiring color data from input color devices like cameras and

scanners, and managing color data for display, printing, and storing. The tutorial also demonstrates how to automate a color management workflow in Mac OS X.

Benefits: Tutorial participants will be able to:

- Get an overview of the color management architecture in Mac OS X
- Become familiar with the principles of color management in ColorSync
- Understand the role of drivers for color devices in Mac OS X color management
- Understand different mechanisms of color management in the application running on Mac OS X
- Apply the knowledge from the course to solve practical problems of color processing on Mac OS X

Intended Audience: engineers, scientists, project managers, pre-press professionals, and others confronting color management issues.

Luke Wallis is a Senior Scientist in ColorSync group at Apple Computer. His responsibilities include color color management in Mac OS X and ColorSync framework.

T4B: Color Management Concepts for Digital Imaging Systems

10:20 am–12:20 pm (2 hours)

Instructor: Kevin Spaulding, Eastman Kodak Company

Color management technology enables predictable and desirable color reproduction to be achieved in digital imaging systems. This tutorial will discuss color management concepts in the context of an image state architecture that has been developed to describe the relationship between various types of digital images, image capture and display devices, image processing workflows, and digital color encodings. Color management will be presented as five connected classes of operations including input, rendering, unrendering, effects, and output. The characteristics and properties of color management transforms used for each of these basic operations will be described together with a discussion of how these

transforms can be implemented in the framework of the ICC Color Management System.

Benefits: This course will enable the attendee to:

- Describe common digital imaging workflows within the context of an image state architecture model
- Understand the characteristics and uses of commonly encountered color encodings (e.g., sRGB, sYCC, ICC PCS, RIMM/ROMM RGB, etc.)
- Distinguish between the different types of color management transformations used in digital imaging systems
- Recognize the relationship between color management systems and the image state architecture model

Intended Audience: scientists, engineers, analysts, and managers involved in the design, engineering, manufacturing, marketing, or evaluation of digital imaging systems.

Kevin Spaulding received a BS in Imaging Science from Rochester Institute of Technology (1983), and MS and PhD degrees in Optical Engineering from the University of Rochester (1988 and 1992). He has been with Eastman Kodak Company since 1983 where he is currently a Senior Principal Scientist in the Inkjet Systems Division. Spaulding serves on several international standards committees that are working on the standards pertaining to the unambiguous communication of digital color image data in digital imaging systems. His research interests include color reproduction, digital halftoning, image processing algorithms for digital camera and printers, and image quality metrics.

T4C: The Art and Science of Creating ICC Profiles for Input, Output and Display Devices

1:30–5:30 pm (4 hours)

Instructor: Franz Herbert,
Integrated Color Solutions, Inc.

This course describes how to successfully create ICC profiles as a combination of applying sound science and understanding the many issues that occur with different devices. It highlights why numerics, as well

as process control, are major factors in color management. The differences between device calibration and profiling are addressed. Measurement instruments are analyzed and compared, and the impact of optical brighteners in paper on spectrometry reviewed. In a hands on experience we create profiles for a variety of devices, starting with a digital camera and ending with comparing a proof to a monitor/projector simulation of that proof.

Benefits: This course will enable the attendee to:

- Understand the basic principles behind creating ICC profiles
- Comprehend the differences between profiles for different device classes:
 - monitors (CRTs, LCDs, etc.)
 - scanners
 - digital cameras
 - projectors
 - color printers (ink jet, dye sublimation, xerography, etc.)
 - printing presses
- Evaluate the trade offs between different approaches
- Formulate a strategy that leads to usable profiles
- Assess the quality and precision of profiles

Intended Audience: engineers and scientists who have the need to either create, modify, or use ICC profiles. Attendees will benefit from familiarity with basic color science and color management.

Franz Herbert has been developing award-winning software for more than 20 years. In 1994, he introduced the world's first complete color management system, ColorBlind[®], to the market place. He is currently VP Research & Development at Integrated Color Solutions, Inc. (ICS), where his latest product, Remote Director[™], has redefined how the printing industry does proofing. Herbert holds three patents related to soft proofing technology and color control.

CIC15 Hotel Registration

Name _____
Title/Position _____
Company _____
Mailing Address _____

Telephone _____ Fax _____ Email _____

Reservations Deadline: October 15, 2007

Hotel Albuquerque at Old Town

800 Rio Grande Boulevard NW
Albuquerque, New Mexico 87104
telephone 505/843-6300; toll-free 800/237/2133; fax 505/842-8426
www.hotelabq.com

A special block of rooms at a discounted rate (\$105 single/double) is being held at the Hotel Albuquerque at Old Town for the nights of November 3-11. The discounted rate will be extended for three days before and after these dates if rooms are available. To guarantee a room, a valid credit card must be given to hold your reservation. Reservations received after Oct. 15, 2007 will honor the group rate on a space available basis.

Check in time: 3:00 pm Checkout time: noon
Room rates: \$105 single/double
+ 12.875% state and local taxes

Reservations may be made by visiting www.imaging.org/conferences/cic15/hotel.cfm. You may also fax this form to 505/842-8426 or call the hotel directly at 505/843-6300, 800/237-2133, or 866/505-7829 and telling them you are with the "IS&T Color Imaging Conference."

Please reserve my room as indicated:

Arrival Time/Date _____ Departure Date _____
___ Single ___ Double
___ Special Requirements (please indicate): _____

Deposit: ___ AMEX ___ MC ___ VISA ___ Discover
Card# _____ Exp. Date _____
Name of cardholder _____

Notice of cancellation must be given to the hotel 24 hours prior to arrival date to receive a full refund. Be sure to obtain a cancellation number.

There is no charge for children under 18 years when sharing a room with a parent.

The Hotel Albuquerque at Old Town is a smoke-free facility.

Transportation Notes: Information on flights in/out of Albuquerque, as well as ground transportation, can be found at www.cabq.gov/airport/.

The Sunport Shuttle provides convenient shuttle services between Albuquerque International Sunport and the Hotel Albuquerque for \$14.00 one way and \$26.00 round trip, per person. The Sunport Shuttle check-in counter is conveniently located inside the airport on the Baggage Claim level across from Southwest's Baggage Carousel No. 3. If you are traveling in a group the fee goes down after the 5th person to \$5.00/person. The shuttle runs from 4am until 11pm. For reservations and more information, please visit www.sunportshuttle.com or call 505/883-4966.

Taxi Service is also available at the terminal. The typical minimum charge is \$25.00. For more information and services call Albuquerque Cab Company 505/883-4888 or Yellow Cab Company 505/247-8888.

CIC15 Conference Registration

Name _____
 Title/Position _____
 Company _____
 Mailing Address _____

 Telephone _____ Fax _____ Email _____

Conference registration includes admission to all technical sessions, the full-color conference proceedings with CD, coffee breaks, and ticketed receptions. Separate registration fees are required for tutorials. Register online at www.imaging.org/conferences/CIC15.

Conference Registration (CHECK ONE)	IS&T/SID Member	Non-member	TOTAL
<i>After October 5, add \$50 to the appropriate fee below.</i>			
___ Technical Registration	\$620	\$730	\$ _____
___ Student (ID required)	\$150	\$180	\$ _____
___ Speaker/Session Chair	\$500	\$590	\$ _____

Proceedings			
___ Extra copy	\$90		\$ _____

Tutorial Registration (be sure to multiply number of classes by per course fee and place on total line)			
<i>After October 5th, add \$50 to the appropriate fee below.</i>			
___ 2-day Hunt Course	\$650	\$825	\$ _____
___ 2-day Hunt Course Student	\$350	\$425	\$ _____
___ 1-day Practical Apps of Measurement	\$300	\$350	\$ _____
___ 1-day Practical Apps of Measurement Student	\$175	\$200	\$ _____

<i>After October 5th, add \$30 to the appropriate fee below. Students add \$20.</i>			
___ 4-hour tutorial <input type="checkbox"/> T4C	\$230	\$275	\$ _____
___ 4-hour tutorial Student <input type="checkbox"/> T4C	\$50	\$50	\$ _____
___ 2-hour tutorial (per class)	\$150	\$195	\$ _____
___ 2-hour tutorial Student (per class)	\$50	\$50	\$ _____

Check all that apply: T1A T1B T1C T2A T2B T2C
 T3A T3B T3C T3D T4A T4B

Sign up for three 2-hour classes and get the fourth free! To take advantage of this offer, you must fill out this form and submit via fax. You cannot register for this option online.

I am taking three classes. My fourth, free class, is: _____

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 join now and calculate your fees based on membership rates; new memberships paid for now expire 12/31/08

GRAND TOTAL \$ _____

Payment Method: Check (Check # _____) AMEX MC VISA Discover
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Return this form with signed credit card authorization or check payable in US dollars to
 IS&T, 7003 Kilworth Lane, Springfield, VA 22151 • 703/642-9090; 703/642-9094 fax; info@imaging.org

Please note: To cover bank charges and processing fees, there is a cancellation fee of \$75 dollars until October 5, 2007. After that date, the cancellation fee is 50% of the total plus \$75. All requests for refund must be made in writing. No refunds will be given without a written request after November 10, 2007.