



IS&T REPORTER

"THE WINDOW ON IMAGING"

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SELECTED BEST PAPER AWARD ABSTRACTS: ELECTRONIC IMAGING SYMPOSIUM 2010

Best Paper Digital Photography Conference

Texture-Based Measurement of Spatial Frequency Response using the Dead Leaves Target: Extensions and Application to Real Camera Systems

J. S. McElvain,¹ S. P. Campbell,¹ E. Jin,² and J. Miller¹;

¹Digital Imaging Systems and ²Aptina LLC (USA)

Abstract: The dead leaves model was recently introduced as a method for measuring the spatial frequency response (SFR) of camera systems. The target consists of a series of overlapping opaque circles with a uniform gray level distribution and radii distributed as r^{-3} . Unlike the traditional knife-edge target, the SFR derived from the dead leaves target will be penalized for systems that employ aggressive noise reduction. Initial studies have shown that the dead leaves SFR correlates well with sharpness/texture blur preference, and thus the target can potentially be used as a surrogate for more expensive subjective image quality evaluations. In this paper, the dead leaves target is analyzed for measurement of camera system spatial frequency response. It was determined that the power spectral density (PSD) of the ideal dead leaves target does not exhibit simple power law dependence, and scale invariance is only loosely obeyed. An extension to the ideal dead leaves PSD model is proposed, including a correction term to account for system noise. With this extended model, the SFR of several camera systems with a variety of

formats was measured, ranging from 3 to 10 megapixels; the effects of handshake motion blur are also analyzed via the dead leaves target.

Best STUDENT Paper Digital Photography Conference

Direct PSF Estimation Using a Random Noise Target

J. Bravers, C. Seiler, and T. Aach, RWTH Aachen (Germany)

Abstract: Conventional point spread function (PSF) measurement methods often use parametric models for the estimation of the PSF. This limits the shape of the PSF to a specific form provided by the model. However, there are unconventional imaging systems like multispectral cameras with optical bandpass filters, which produce an abnormal, e.g., unsymmetric PSF. To estimate such PSFs we have developed a new measurement method utilizing a random noise test target with markers: After acquisition of this target, a synthetic prototype of the test target is geometrically transformed to match the acquired image with respect to its geometric alignment. This allows us to estimate the PSF by direct comparison between prototype and image. The noise target allows us to evaluate all frequencies due to the approximately "white" spectrum of the test target - we are not limited to a specifically shaped PSF. The registration of the prototype pattern gives us the opportunity to take the specific spectrum into account and not just a "white" spectrum, which might be a weak assumption in small image regions. Based on the PSF measurement, we perform a deconvolution. We present comprehensive results for the PSF estimation results using our multispectral camera and provide deconvolution results.

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

* These papers were presented at the Electronic Imaging Symposium, held January 17-21, 2010, in San Jose, CA.

Best Paper
Multimedia on Mobile Devices Conference
Mobile Cosmetics Advisor:
An Imaging Based Mobile Service

N. T. Bhatti,¹ H. Baker,¹ H. Chao,¹ M. H. Clearwater,¹
 J. Jain,¹ N. Lyons,¹ J. Marguier,² J. Schettino,¹ and
 S. Susstrunk²; ¹Hewlett-Packard Labs. (USA) and ²Ecole
 Polytechnique Federale de Lausanne (Switzerland)

Abstract: Mobile imaging applications are emerging as an area of serious academic and commercial interest. In this paper we present a unique ubiquitous consumer application targeted at aiding women in their selection of personal cosmetic products. Selecting cosmetics requires visual information and often benefits from the assessments of a cosmetics expert. We derive the visual information from analysis of camera phone images tolerating a wide variety of lighting conditions and camera quality. After the application of unique color correction, face detection, and skin color estimation the system provides expert cosmetic advice through the use of a developed expert system. The result is a new paradigm for mobile interactions-image-based information services exploiting the ubiquity of camera phones. The application is designed to work with any handset over any cellular carrier. Targeted at consumers, it must be quick and easy to use, not requiring sophisticated download capabilities. All application processing occurs in the back-end system and not on the handset itself. We present the imaging pipeline technology, a comparison of the services' accuracy with respect to human experts, and a discussion of the prototype's architecture and design tradeoffs.

Best STUDENT Paper
Multimedia on Mobile Devices Conference
Fused Number Representation Systems
for Barcode Applications

S. Agaian, Stanford University (USA)

Abstract: In this paper, we introduce a new concept of generating number representation systems and its applications. The new system fuses a number of representation systems that use multiplication, addition, and other operators. We show how this fused system can improve image processing applications. By using the fused system, we argue, one can generate very secure, reliable, and high capacity color barcodes. The representation, symbols, and colors may be used as encryption keys that can be encoded into barcodes, thus eliminating the direct dependence on cryptographic techniques. To supply an extra layer of security, the fused system also allows one to encrypt given data using different types of encryption methods.

Best STUDENT Paper
Multimedia on Document Recognition and Retrieval Conf.
A Word Language Model Based Contextual
Language Processing on Chinese Character Recognition

C. Huang, X. Ding, and Y. Chen, Tsinghua University (China)

Abstract: The language model design and implementation issue is researched in this paper. Different from previous research, we want to emphasize the importance of n-gram models based on words in the study of language model. We build up a word based language model using the toolkit of SRILM and implement it for contextual language processing on Chinese documents. A modified Absolute Discount smoothing algorithm is proposed to reduce the perplexity of the language model. The word based language model improves the performance of post-processing of online handwritten character recognition system compared with the character based language model, but it also increases computation and storage cost greatly. Besides quantizing the model data non-uniformly, we design a new tree storage structure to compress the model size, which leads to an increase in searching efficiency as well. We illustrate the set of approaches on a test corpus of recognition results of online handwritten Chinese characters, and propose a modified confidence measure for recognition candidate characters to get their accurate posterior probabilities while reducing the complexity. The weighted combination of linguistic knowledge and candidate confidence information proves successful in this paper and can be further developed to achieve improvements in recognition accuracy.

Best Paper*
Media Forensics and Security Conference
The Square Root Law of Steganographic
Capacity for Markov Covers

Tomas Filler,¹ Andrew D. Ker,² and Jessica Fridrich¹;
¹Binghamton University (USA) and ²University of Oxford (UK)

Abstract: Sensitivity analysis attacks aim at estimating a watermark from multiple observations of the detector's output. Subsequently, the attacker removes the estimated watermark from the watermarked signal. In order to measure the vulnerability of a detector against such attacks, we evaluate the fundamental performance limits for the attacker's

[continued on page 8](#)

* This conference awarded second and third place best papers as well. Second prize went to "Exhibition QIM-Based Watermarking for Digital Cinema," Pilar Callau, Rony M. Darazi, and Benoît Macq, Université Catholique de Louvain (Belgium); third prize to "Joint Detection-Estimation Games for Sensitivity Analysis Attacks," Maha M. El Choubassi and Pierre Moulin, University of Illinois at Urbana-Champaign (USA)

EI2010 Says Farewell to San Jose Location with Exciting Offerings and Looks Toward New Venue

By Jan Allebach, EI 2010 Symposium Chair

The 22nd Annual IS&T/SPIE Electronic Imaging Symposium took place this year from Sunday 17 January to Thursday 21 January in San Jose, California at the San Jose Convention Center and adjoining Marriott Hotel. This event served as an umbrella for 18 different conferences organized into six technology areas: 3D Imaging, Interaction, and Measurement (three conferences); Imaging, Visualization, and Perception (five conferences); Image Processing (four conferences); Digital Imaging Sensors and Applications (four conferences); Multimedia Processing and Applications (four conferences); and Visual Communications and Image Processing (one conference).

Typically, each conference consisted of 20 to 50 papers, published in a separate proceedings, which are presented to fellow attendees over one to four day meeting periods. This year more than 642 papers were presented during the four-days of the conference (Sunday is reserved for Short Courses).

The annually-held Symposium brings together a diverse, multidisciplinary global

community of researchers from industry, academia, and government. This year there were 959 attendees from 39 countries (163 from Asia/Pacific region, 277 from Europe/Middle East, 516 from the Americas, and 3 from Africa).

Plenary Presentations

The Symposium featured two plenary talks. Tuesday morning, Avidesh Zakhori (University of California, Berkeley) spoke about using continuous image and laser-range data acquired from both ground-based and airborne platforms to construct 3-D models of a cityscape in her talk "Automatic 3D Modeling and Analysis of Large Scale Urban Environments." Zakhori showed impressive fly-through video sequences of downtown Berkeley that were constructed using the algorithms developed in her laboratory.

On Wednesday, Ed Delp (Purdue University) gave a presentation titled "Hey! What is That in Your Pocket? The Mobile Device Future." Delp challenged those in the audience to think about how they personally employ mobile technologies in their daily lives, and how these habits differ from

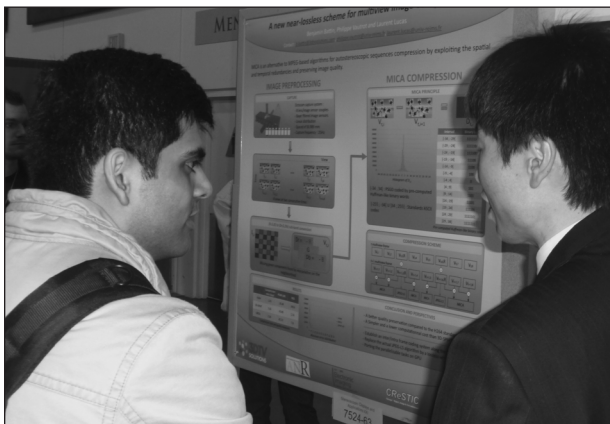
EI2010 STATISTICS

Attendees:	959
Oral Papers:	532
Interactive Papers:	110
Short Courses:	15
Dates:	January 17-21, 2010
Location:	San Jose, CA

those of other user groups. He discussed a range of privacy and security issues associated with mobile devices, and showed applications from his laboratory that demonstrated the use of mobile cameras for autonomous sign translation and monitoring of dietary intake.

Conference and Society Awards

Prior to the plenary talks, a number of awards were presented to recognize some of the outstanding individuals in the electronic imaging community. C.-C. Jay Kuo (University of Southern California) was presented with the 2010 Electronic Imaging Scientist of the Year Award in recognition of his seminal contributions to the areas of visual signal modeling and analysis, multimedia communications, content analysis, and security. It was also noted



Papers are discussed in detail during the joint Interactive Paper/Demonstration session, which also gives authors and companies affiliated with authors an opportunity to showcase products and programs related to their papers.



Photos: Francisco Imoi

that to date, during Kuo's career 95 individuals have received their PhD under his supervision.

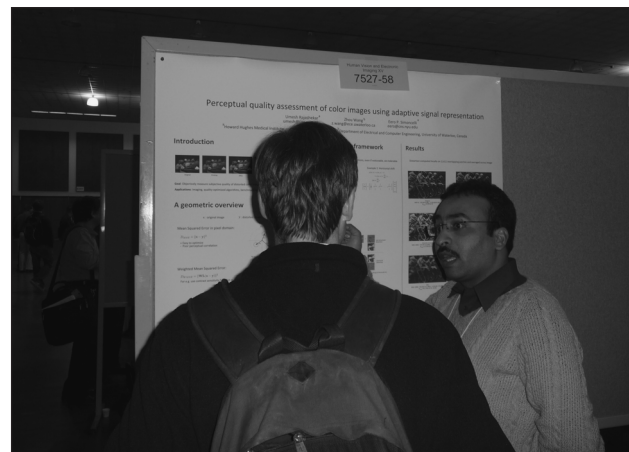
A number of Best Student Paper and Best Paper Awards were given, including:

- A Best Student Paper Award presented by the Document Recognition and Retrieval conference to Chen Huang (Tsinghua University) for "A Word Language Model Based Contextual Language Processing on Chinese Character Recognition."
- A Best Student Paper Award presented by the Multimedia on Mobile Devices conference to Sarkis Agaian (Stanford University) for "Fused Number Representation Systems for Barcode Applications" and a Best Paper Award to Nina Bhatti, Harlyn Baker, Hui Chao, Scott Clearwater, Mike Harville, Jhilmil Jain, Nic Lyons, Joanna Marguier, John Schettino, and Sabine Süssstrunk (Hewlett-Packard Laboratories and EPFL) for "Mobile Cosmetics Advisor: An Imaging Based Mobile Service."
- A Best Student Paper Award presented by the Digital Photography conference, to Johannes Brauers (RWTH Aachen), for "Direct PSF Estimation Using a Random Noise Target" and a Best Paper Award to Jon McElvain (Digital Imaging Systems) for "Texture-based

Measurement of Spatial Frequency Response Using the Dead Leaves Target: Extensions and Applications to Real Camera Systems."

- A Best Paper Award presented by the Image Processing: Machine Vision Applications conference to Shane McClure (University of Waikato), for "Resolving Depth-measurement Ambiguity with Commercially Available Range Imaging Cameras."
- Five Best Paper Awards presented by the Visualization and Data Analysis conference to Yeseul Park and Jinah Park (KAIST), for "Interactive Visualization of Fuzzy Set Operations;" to Ming C. Hao, Umeshwar Dayal, Ratnesh Kumar Sharma, Daniel A. Keim, and Halldór Janetzko (Hewlett-Packard Laboratories) for "Visual Analytics of Large Multidimensional Data Using Variable Binned Scatter Plots;" Han Suk Kim, Jurgen P. Schulze, Angela C. Cone, Gina E. Sosinsky, and Maryann E. Martone (University of California, San Diego) for "Multi-channel Transfer Function with Dimensionality Reduction;" Tobias Schreck, Tatiana von Landesberger, and Sebastian Bremm (Technische Universität Darmstadt) for "Techniques for Precision-Based Visual Analysis of Projected Data;" and Robert E. Erbacher and Deborah A. Frincke (Utah State University and Pacific Northwest National Laboratory) for "Cognitive Task Analysis of Network Analysts and Managers for Network Situational Awareness."
- A conference keynote award also presented by the Visualization and Data Analysis conference to Umeshwar Dayal, for "Visual Analytics for Operational Business Intelligence."

IS&T presented its highest award—



Umesh Rajashekar discusses his paper, "Perceptual Quality Assessment of Color Imagings Using Adaptive Signal Representation."

Photo: Diana Gonzalez

Honorary Membership—to James Larimer (ImageMetrics LLC) and recognized new Fellow Raja Bala (Xerox Corp.). It also presented an IS&T Service Award to Michael Kriss (MAK Consulting), the Bowman Award for teaching/mentoring to Giordano Beretta (Hewlett-Packard Labs), and the Charles E. Ives/Journal Award to Masahiro Yamaguchi, Hideaki Haneishi, and Nagaaki Ohyama.

Network Opportunities and Conference Highlights

The Interactive Paper/Demonstration Session on Tuesday evening and the Symposium Reception on Wednesday evening were again highlights of the Symposium. During the combined Interactive Paper Session, approximately 110 posters were presented and generated a lively exchange between authors and attendees. The collocated unique Symposium Demonstration Session provided an opportunity for authors of papers presented at EI to showcase their technologies in a tabletop setting. This year there were 43 separate demonstrations. On the following evening, the EI reception reprised the new format that was first introduced in 2009 with interactive 3D gaming areas, raised "lounge areas," and salad, pizza, and cupcakes as the culinary fare.

Attendees also were treated to targeted product exhibits showcasing imaging technology, a phantogram display, and an interactive 3D simulation display.



Photo: Diana Gonzalez

IS&T 2009 Awards presented at EI included Fellowship to Raja Bala (Xerox Corporation).



Photos: Diana Gonzalez

New Conferences Expand Scope of EI

This year there were two new conferences. 3D Image Processing (3DIP) and Applications addressed a range of topics associated with 3D imaging, including 3D analysis, feature extraction, and segmentation; 3D face recognition; multiview coding and 3D TV; 3D reconstruction from 2D views; 3D compression and watermarking; 3D shape matching, indexing, and retrieval; 3D and 4D image capture; and 3D visualization, 3D display, and quality assessment.

Imaging and Printing in a Web 2.0 World explored the use of the web as a platform for media creation, and the creation of print media from web content. A number of papers addressed aspects of on-line digital processing of photos and photo document creation. The conference began with a fascinating presentation by Bernardo Huberman of HP Labs on statistical characterization of web usage.

The returning conferences continued to exhibit the energy and creativity that is the heart of the Electronic Imaging Symposium. Just to mention a very few of the highlights:

- Stereoscopic Displays and Applications XXI hosted a special keynote presentation on three-dimensional storytelling by Bob Whitehill from Pixar Animation.
- The Engineering Reality of Virtual Reality 2010 explored the use of im-



- mersive environments for special skills training, engineering design, and collaboration.
- Human Vision and Electronic Imaging XV included a session on the novel topic of artificial retinas and a presentation by John Sexton on his collaboration with Ansel Adams. This was followed by a tour of the exhibit of the early work of Adams at the San Jose Museum of Art.
- Document Recognition and Retrieval XVII included invited presentations by Craig Knoblock from the University of Southern California on finding and understanding raster maps and by Hiroshi Sako of Hitachi on banknote validation and retrieval in cash-recycling automated teller machines.
- Intelligent Robots and Computer Vision XXVII included several papers on design of robots for space exploration. The conference also explored novel approaches for tracking humans, including a paper on measurement of ski-jumper trajectories by

Top Left: The excitement of 3D was as prevalent at EI2010 as it has been in year's past, as witnessed by a new 3D TV monitor (top left); the Phantogram Exhibit, curated by Terry Wilson, generated much interest (top right); and 3D gaming during the conference reception (left).

combining stereo vision and active shape models.

New Venue for EI2011

Next Year's Symposium will take place 23-27 January 2011 at the San Francisco Airport Hyatt Regency. We believe that this location will be

more convenient and less costly for attendees, as well as provide them with the opportunity to visit the Photonics West exhibit, which will be taking place at the same time as EI at the Moscone Center in San Francisco. EI occurs one week later than it has in recent years in order for it to be held during the same week as Photonics West. Free shuttle service will be provided from the EI venue to the exhibit. The new location also offers close proximity to San Francisco Airport (SFO), making it especially easy to reach by air from worldwide locations; a number of restaurants within walking distance of the hotel; shuttles to the restaurant-rich town of Burlingame; and a convenient base for sightseeing in San Francisco.

Sabine Süsstrunk (EPFL) is the 2011 symposium chair and Majid Rabbani (Eastman Kodak Company) is the symposium co-chair. Abstracts for the meeting are due 28 June 2010. additional details may be found at <http://electronicimaging.org>. We hope to see you there! ▲

STANDARDS UPDATE:

by Eric Zeise (Eastman Kodak Company); David Q. McDowell, Editor

The material for this Standards Update column was provided by Eric Zeise (Eastman Kodak Company), who is the convenor of WG 4 of JTC 1/SC28. It is based on material provided by Choon-Woo Kim (Inha University, Korea), convenor of SC28 AWG, Paul Jeran (Hewlett Packard Company), convenor of SC28 WG 2, Dwight Lewis (Lexmark International Inc.), convenor of WG 3, and Fumio Nakaya (Fuji-Xerox Company, Ltd.), convenor of WG 5.

Zeise has been a US Expert to JTC1/SC28 for 12 years, as well as an active member of the USTAG to SC28, which is part of INCITS (InterNational Committee for Information Technology Standards).

ISO/IEC JTC-1 SC28 Office Equipment

The focus of the standardization activities within SC28 has been on product specification descriptors, methods for measurement of hardcopy device productivity, hardcopy output quality and consumables yield of ink and toner cartridges. Standardization of the environmental and accessibility characteristics of office equipment is a continuing area of interest. Two recent development activities within SC28 are in the areas of management of colour consistency characteristics within office equipment and high-level office application workflow compatibility.

There are currently five active working groups within SC28:

- AWG (Advisory working group)
- WG2 (Consumables)
- WG3 (Productivity)
- WG4 (Image quality)
- WG5 (Office colour)

Advisory Working Group

The AWG is responsible for identifying future office equipment standardization activities from the perspective of both user needs and technology needs, as well as identifying opportunities for collabora-

tion or liaison with other standardization bodies.

It has recently concluded a multinational survey of market and technology needs for international standardization in the area of office equipment. Based on the results of the survey and feedback from working groups and national bodies, AWG has updated the SC28 roadmap for standardization.

To satisfy the needs for standardization in the office colour area, AWG has initiated the establishment of a new working group, WG5, which is responsible for "office color" standardization activities. AWG is also investigating possible new work items related to software applications interoperability. As a result of a Partner Standards Development Organization cooperation agreement, AWG has invited presentations from the IEEE P2600 working group and the IEEE-ISTO Printer working group to investigate establishment of liaison relationships.

WG 2, Consumables

WG2 is responsible for the standardization of measures for the characteristics of consumables in office equipment.

Work is progressing well on the latest addition to the yield standards, ISO/IEC 29102, *Method for determination of ink cartridge photo yield for colour ink jet printers*, and a set of corresponding test files in ISO/IEC 29103, *Colour pages for the measurement of photo yield*. A new CD draft of ISO/IEC 29102 will be issued early in 2010. Another version of the test pages is currently under review.

The purpose of these standards is to determine the photo yield (number of standard test pages printed per ink-jet cartridge) using a six-page suite of composite images selected to sample a broad range of consumer imaging.

Work is also moving forward on a five-part Cartridge Characterization stan-

dard. The first working drafts were reviewed at the last meeting in Vienna and the editors are working on the next drafts for the committee to review at a meeting prior to the SC28 Plenary in June.

Part 1 covers terms, symbols, notations and a framework for characterizing toner and ink cartridges used in digital printing devices. Part 2 includes reporting and packaging labelling provisions. Part 3 establishes uniform, measurable provisions regarding the environmental impact of toner and ink cartridges throughout the product life-cycle. Part 4 defines characterization attributes and associated test methods for ink cartridges. Part 5 defines characterization attributes and associated test methods for toner cartridges.

WG 3, Productivity

WG 3 is responsible for the standardization of productivity assessment procedures for office equipment.

Two WG3 standards projects to address productivity measurements of printing and copying devices have resulted in standards published 2009. These are ISO/IEC 24734:2009, *Method for measuring digital printer productivity* and ISO/IEC 24735:2009, *Method for measuring digital copying machine productivity*. They were developed with close coordination and review between the two teams and both standards utilize similar metrics and measurement methods.

A four-page document is used for evaluation (in hardcopy for copying, or in digital form for printing). Three new productivity metrics were defined:

- First Set Out Time (FSOT) measures the time (in seconds) to print or copy one set of the four-page document.
- Estimated Saturated Throughput (ESAT) measures the rate at which subsequent sets of the four-page document are created and is reported in images per minute.

- Effective Throughput (EFTP) measures the average speed at which the four-page sets are produced, measured from the initiation of the job to the end of the last page of the last set. Three EFTP measurements are recorded, intended to indicate the productivity of the device with differing job lengths (one set, one set plus thirty seconds and one set plus four minutes). EFTP is reported in images per minute.

A minimum evaluation must be conducted for FSOT and ESAT using the device's "out of box" (default) mode. If desired, optional testing may be performed to determine EFTP and to determine any of the metrics in other print/copy modes. Minimum reporting requirements have also been defined, including having the detailed test information available upon request.

A companion standard, ISO/IEC 29183, *Method for measuring digital copying productivity of a single one sided original*, is nearing publication. This standard addresses the copying configuration in which collation and an automatic document feeder are not available. Metrics, evaluation and reporting employed in this standard are similar to those used in ISO/IEC 24735.

WG 4, Image Quality Assessment

WG4 is responsible for the standardization of image quality assessment procedures for office equipment and currently has three projects:

- ISO/IEC 24790, *Measurement of image quality attributes for hardcopy output – monochrome text and graphics images*;
- ISO/IEC 29112, *Test charts and methods for measuring monochrome printer resolution*; and
- Infrastructure necessary for the evaluation of reflection scanners as analytic measurement devices.

ISO/IEC 24790 specifies device and technology-independent methods for the evaluation of major text and graphics image quality attributes of reflection prints

produced by digital printers. The attributes and their measurement methods rely on intrinsic properties of the analyzed images and provide image quality measures which are largely independent of the rendition or technology details of the printing devices under evaluation. A first CD has been registered and a revised version is planned for circulation prior to the next meeting.

ISO/IEC 29112 specifies a set of evaluation methods for the five major image quality attributes contributing to perceived resolution in hardcopy digital printing systems. These are 1) native resolution (e.g. DPI), 2) effective resolution (evaluating the ability of resolution enhancement hardware to shift edges at higher than device native resolution), 3) edge blurriness, 4) edge raggedness, and 5) the overall MTF capability of a printing system.

The intent of this standard is to provide methods for the engineering evaluation of these five image quality attributes. A first CD has been registered and detailed evaluation and further optimization of the measurement methods is underway.

The study of reflection scanners as analytic measurement devices is based on the realization that although reflection scanners can provide an immense amount of data about a reflection print very quickly, they are only incidentally designed as analytic instruments. This work builds upon several standards developed by ISO TC42 (Photography) for the evaluation of camera tone-scale (ISO 14524), noise (ISO 15739) and dynamic range (ISO 21550) characteristics as well as scanner resolution characteristics (ISO 16067-1). It adds measures of temporal and spatial uniformity, spatial distortion, flare, and compensation for finite sharpness characteristics of a target or measuring device in evaluating reflection printer MTF characteristics.

WG 5, Office Colour

WG 5 was recently established to be responsible for the standardization of colour characteristics management in office equipment.

The item currently under development is ISO/IEC TR29186, *Test method for colour gamut mapping algorithms*. This technical report is intended to be a supplement for CIE 156:2004, *Guidelines for the Evaluation of Gamut Mapping Algorithms*. It builds upon the work of the International Color Consortium, ISO TC130, IEC/TC100, and the CIE.

The TR is designed to be applicable to both colour softcopy and hardcopy in office use and defines test charts, test chart image processing workflow, media, viewing conditions, measurements, colour spaces and experimental methods which either do not exist in CIE 156, or differ substantively from the methods of CIE 156.

Recent published SC28 standards

In addition to those mentioned above SC28 has recently published the following standards.

ISO/IEC 10779:2008, *Accessibility guidelines for elderly persons and persons with disabilities*

ISO/IEC 28360:2007, *Determination of chemical emission rates from electronic equipment*

ISO/IEC 19799:2007, *Method for measuring gloss uniformity on printed page*.

ISO/IEC 24711:2007, *Method for the determination of ink cartridge yield for colour ink jet printers and multi-function devices that contain printer components*

ISO/IEC 24712:2007, *Colour test pages for measurement of office equipment consumable yield*

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

estimation problem. The inverse of the Fisher information matrix provides a bound on the covariance matrix of the estimation error. A general strategy for the attacker is to select the distribution of auxiliary test signals that minimizes the trace of the inverse Fisher information matrix. The watermark detector must trade off two conflicting requirements: (1) reliability, and (2) security against sensitivity attacks. We explore this tradeoff and design the detection function that maximizes the trace of the attacker's inverse Fisher information matrix while simultaneously guaranteeing a bound on the error probability. Game theory is the natural framework to study this problem, and considerable insights emerge from this analysis.

Best Paper*
Visualization and Data Analysis Conference
Interactive Visualization of Fuzzy Set Operations

Y. Park, Korea Advanced Institute of Science and Technology (Korea)

Abstract: Fuzzy sets provide degree of confidence or membership for each element belonging to the sets. We design a disk diagram with an augmented frequency graph to visualize elements in a fuzzy set. It shows the distribution of the elements within the set with respect to the membership function value. Fuzzy set opera-

tions—like intersection—are used to select the elements of interests with certain degree of confidence. However, it is difficult to grasp the relationship among the sets. With the proposed disk diagram representing a fuzzy set, we propose an interactive visualization system to analyze fuzzy data. By interactively overlapping the disk diagrams, a user can not only bring out the individual elements of interests, but also overview the whole data elements associated with the sets. Furthermore, we investigated two different visualization scenarios for intuitive interpretation of the visualization results. We demonstrate the proposed visualization system with a terrorist analysis output dataset.

**This conference awarded five best papers. The four others are “Visual Analytics of Large Multidimensional Data Using Variable Binned Scatter Plots,” M. C. Hao, U. Dayal, and R. K. Sharma, Hewlett-Packard Labs. (USA), and D. A. Keim and H. Janetzko, Universität Konstanz (Germany); “Multichannel Transfer Function with Dimensionality Reduction,” H. S. Kim, J. P. Schulze, A. C. Cone, G. E. Sosinsky, and M. E. Martone, University of California, San Diego (USA); “Techniques for Precision-Based Visual Analysis of Projected Data,” T. Schreck, T. von Landesberger, and S. Bremm, Technische Universität Darmstadt (Germany); and “Cognitive Task Analysis of Network Analysts and Managers for Network Situational Awareness,” R. F. Erbacher, Utah State University, and D. A. Frincke, Pacific Northwest National Lab. (USA). ▲*

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Executive Editor: Peter Burns
 Managing Editor: Donna Smith
 Standards Editor: David McDowell

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Imaging.org focuses on all aspects of imaging, with particular emphasis on digital printing, electronic imaging, image perception, photo fulfillment, color imaging, image preservation, digital fabrication, and the physics and chemistry of imaging processes. For more information, visit imaging.org.

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

Please send inquiries to: info@imaging.org
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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 Süssstrunk and Majid Rabanni

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www.imaging.org/ist/Conferences/.

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