



IS&T

# REPORTER

"THE WINDOW ON IMAGING"

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## Digital Printing and Fabrication/NIP31

### A Simple Model for DoD Inkjet Frequency Response

Stephen D Hoath, University of Cambridge (UK)

**Abstract:** A simple linear model of piezo DoD inkjet print-head jetting output (drop speed, volume, momentum) provides an analytic prediction for the frequency response for steady state and initial printing streams from nozzles. The model has been applied to both existing commercial and development inkjet print-head devices.

### Designing a Long-Life, Page-Wide Print-Head

Stephen Conner, Lisa Underwood, Minal Shah, Thom Sabo, Clayton Holstun, Brian Canfield, and Curt Voss, Hewlett-Packard Company (USA)

**Abstract:** This paper discusses three key concepts we used to develop a pagewide printhead designed for a long service life. First we analyzed the product goals as well as past products' strengths and weaknesses. This resulted in a product reliability specifications and an initial identification of which areas needed reliability improvements.

### Application of Inkjet Printing for 3D Integration

Kim Eiroma and Heikki Viljanen, VTT Technical Research Centre of Finland (Finland)

**Abstract:** Inkjet printing is an attractive deposition tool to complement the traditional processing methods used in micro-electronics integration. Its maskless, digital and non-contact nature provides many generic benefits, such as savings in processing steps and material usage, production flexibility and scalability to large areas. In addition, inkjet printing can be utilized in the integration of e.g. silicon and polymer or paper based systems, such as for the new wave of hybrid large-area,



Photo: Suzanne Grinnan.



Photo: Diana Gonzalez.

The Demonstration Session at the Digital Printing and Fabrication/NIP Conference features many 3D-printed objects and always draws a crowd.

Trevor Snyder, 3D Systems, shows off some of his creations. Inset: Close up of 3D-printed "vehicle with wheels and gears.

flexible devices, which are out of the scope of traditional clean room processing.

In this paper, we study the process of metallization of a Through-Silicon Via hole (TSV) by inkjet deposition. We describe the process of sample preparation and characterization. We finally demonstrate the creation of a fully inkjet printed 3D electrical interconnection using a Kelvin TSV test structure.

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To view the full papers of these abstracts for no fee go to [www.imaging.org/ist/publications/reporter/index.cfm](http://www.imaging.org/ist/publications/reporter/index.cfm)

\* Papers were presented at Digital Printing and Fabrication/NIP31, held September 27-October 1, 2015, in Portland, Oregon.

# MORE THAN PRINTING

## CONFERENCE HIGHLIGHTS WHAT IT MEANS TO “PRINT” NOW

By 2015 General Chair Masahiko Fujii, Fuji Xerox

The 2015 Digital Printing and Digital Fabrication/NIP31 Conference—held under the theme “more than printing” and featuring special sessions on single-pass (page-wide) printing, as well as 3D printing and additive manufacturing—took place in Portland, Oregon, September 27 to October 1.

After a successful day of short courses and a Welcome Reception where participants reunited and deepened their friendship with colleagues, the conference opened with a welcome from NIP31 General Chair Masahiko Fujii (Fuji Xerox). Fujii began his remarks by saying that “outstanding technical breakthroughs are made not only through the continuous efforts of mastering a specialized technical area, but through learning about different technical areas and engaging with colleagues who see things from different perspectives. This is a unique conference, one where basic imaging technologies and their applications coexist and reinforce each other. My hope is that all of you participating in this event will meet, react, and create as a result of what you learn this conference, and make innovations based on the imaging technologies.”

### DIGITAL PRINTING AND FABRICATION/NIP31

Attendees*:	351
Oral Papers:	103
Interactive Papers:	9
Short Courses:	16
Exhibitors:	16
Dates:	Sept. 27-Oct. 1, 2015
Location:	Portland, Oregon

\*includes Short Course only and guests

### Conference Kicks off with Balance of Traditional Technologies, Performance Indicators, and Printing of Functional Products

Fujii was joined on stage by Executive Program Chair James Stasiak (Hewlett Packard), who introduced Richard Hague (EPSRC Centre for Additive Manufacturing), the opening keynote speaker. Hague set the tone for interesting discussions throughout the week with his interesting talk “3D Deposition of Functional Materials for the Additive Manufacturing of Smart Devices.”

While many of the conference topics were related to 3D printing technologies during the five-day event, traditional printing was not forgotten. In particular, the Inkjet-based Process session was held over one and a half days, with 16 oral and 1 interactive paper. Topics covered included everything from drop generation to landing on media. Jetting of UV, polymeric, and nanoparticle inks from Piezo, thermal, and continuous ink-jet heads were discussed, as were varied applications such as image printing on off-



Photo courtesy of Masahiko Fujii.

2015 General Chair Masahiko Fujii (Fuji Xerox) with Reinhard Baumann (Fraunhofer Institute for Electronic Nano Systems, ENAS, and Chemnitz University of Technology) who served as Advisory Chair from 2011 - 2015.

set coated paper, to digital fabrication, printed electronics, and 3D printing. The session was well attended with 70 to 140 participants.

Presentations of new measurement and the molecular simulation methods for glass, paper, ink, and toner were presented in the Metrology Tools for Digital Printing Processes Session, while the Performance of Digital Print Products featured nine talks that spanned electrophotography, inkjet, and thermal printing. The presentation “Fire Safety and Inkjet Printed Wallcovering Materials” was especially interesting. Print evaluation methods and image permanence were also discussed at this session.

Highlights of the Digital Fabrication of Functional Products Session were “Application of Inkjet Printing for 3D Integration” and “Manufacturing of Touch Sensors Integrated in Decorative Laminates for Furniture Surface.”

### The Third Digital Revolution and 3D Printing File Formats Featured During Keynotes on Second Day

In 2005, at IS&T first Digital Fabrication Conference, Neil Gershenfeld (Massachusetts



Photo: Diana Gonzalez.

Yair Kipman (far left), CEO of ImagoExpert was one of the exhibitors at the 2015 event.

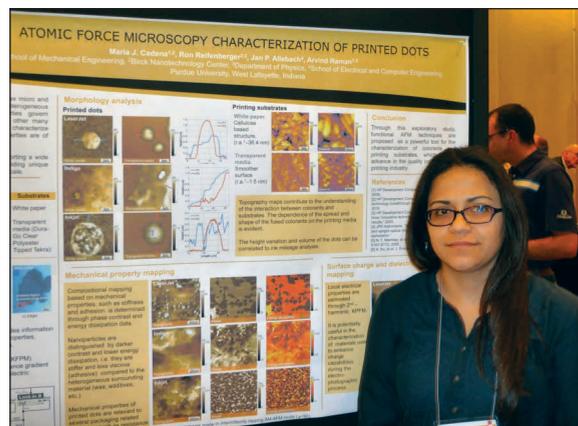
Institute of Technology) challenged attendees to use their technical knowledge of printing to imagine a new world of applications and products brought about by digital fabrication and 3D printing. In his keynote this year, titled “The Third Digital Revolution,” Gershenfeld reviewed the past 10 years and provided a view of the future of digital fabrication sparking many coffee break conversations in its wake. Later Tuesday afternoon, Hiroya Tanaka (Keio University) explained the status of 3D Data formats, including STL, AMF, and 3MF, in this year’s state-of-the-art talk. Following Tanaka’s talk, Eva Rowe (Messe Düsseldorf North America) gave a brief preview of DRUPA2016, which will feature six technology areas. Held every four years, Drupa offers a great chance to see the technical revolution of printing technologies demonstrated.

Recent R&D subjects for electrophotographic (EP) technology tend to focus on efficient optimization by using numerical analysis and quality engineering

(Taguchi Method). Such methods are used in sophisticated ways and achieve further improvements in EP, despite being seen as mature. Through the presentations and discussions in the Toner-Based Processes session, it seems that EP still has the possibility to improve its performance.

EP improvements related to higher image qualities, process optimization and image rendition were also discussed in the Print Systems Optimization Session. The presentation ‘Separation of Granularity into Uniformity Deterioration Factors for Electrophotographic Images’ was particularly interesting. Inkjet was also discussed in the session, with a focus on wide format processes and an introduction of new products.

Next were eight papers presented in the 3D Printing and Additive Manufacturing Session. Topics in this session were the



Maria Cadena (Purdue University) and her poster on Atomic Force Microscopy Characterization of Printing Dots.

Photo: Diana Gonzalez.

accuracy and productivity of 3D additive manufacturing. Voxel data structures for constructing optimal tool paths, estimating fabrication throughput, and comparison of precision and speed were discussed. The other topics included a variety of actual applications of 3D printing. Glass, food material like rice, resin, and UV curable material were used, and several objects formed with these materials were presented. About 100 participants attended this session and the discussions were quite lively.

The day ended with the ever-popular Exhibit Hall Happy Hour featuring the Interactive Paper and Demonstration Session. Participants visited exhibit booths, browsed technical posters, and exchanged information with each other while enjoying some local, world-famous Portland libations.

### Bionics and Single-pass and Security Printing Enliven Third Day

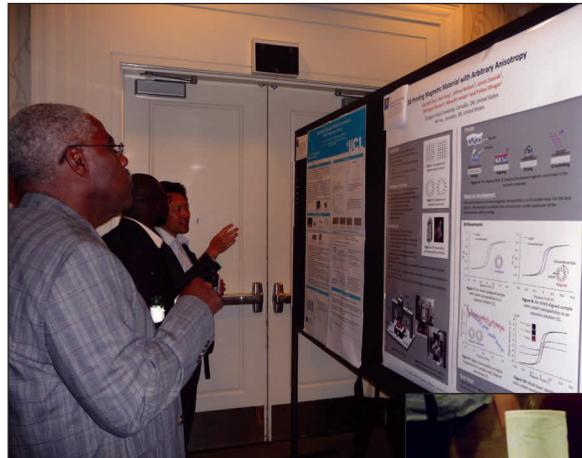
Michael McAlpine (University of Minnesota) gave a fascinating talk about 3D Printed Bionic Nanomaterials during the Wednesday Keynote Session. He demonstrated a “bionic ear” the goal of which is to replicate a fully functional human organ that replicates human ability using embedded electronics and showed preliminary results where a 3D printed guide helps with the regeneration of damaged nerves. Talks later in the day—such as ‘Biopolymer-based Functional Inks for the Preparation of Artificial Cartilage via Bioprinting Technology’ which described preparation of bio ink and evaluation for characteristics of cells.



Photo: Diana Gonzalez.

During the conference, a number of IS&T awards were presented. The Itek Award, in recognition of the best student publication in an IS&T journal, was given to Alvaro J. Rojas Arciniegas (second from left) and Marcos Esterman Jr. (far left), both of RIT, for “Exploring Surface Defects on EP-based 3D-Printed Structures.” Branka Lozo (middle), University of Zagreb, received a Service Award for her service as Publications Chair in 2013 and General Chair in 2014 for the NIP Digital Printing/Digital Fabrication Conference. Hirotooshi Terao (second from right), Alps Electric Co., Ltd., became an IS&T Fellow for outstanding achievement in imaging science or engineering research in high-resolution thermal print head printing. And Reinhard Baumann (far right), Fraunhofer Institute for Electronic Nano Systems (ENAS) and Chemintz University of Technology, received the IS&T Fellow Award bestowed on him in 2014 for outstanding achievement in imaging science or engineering for leadership in the advancement of novel digital and analog printing technologies.

**Right:** The Interactive Paper session provides a time for attendees and presenters to discuss indepth concepts and answer questions related to the poster papers. Concurrently held with the Interactive Paper Session are the Demonstration Session and Exhibit Hall Happy Hour. As part of the Demonstration Session, David Huson (University of the West of England) showed some of his 3D printed objects (**far right**), while Paul O'Dowd (University of the West of England) displayed printed ceramics (**below right**).



Photos: Diana Gonzalez

The well-attended Pagewide Printing Session featured six papers from Hewlett-Packard on single-pass printing technology. Among the talks, Rafael Ulacia presented newly developed pagewide printhead architecture with a nested layout, while Jim Przybyla discussed a high-definition nozzle architecture that uses a new nozzle arrangement to improve image grain and gray transitions. Jose Luis Valero talked about a drop detection system and error hiding algorithms, important in single pass systems, and Martí Rius presented calibration technology.

The three papers presented in the Novel Print Technologies and Extensions Session looked at prediction of changing demand for print service providers, a promising multicolor electrochromic dis-

play device, and high-speed heating heads for thermal printing.

Led by Alan Hodgson (Alan Hodgson Consulting Ltd.) and featuring a Round Table Discussion after the nine presented papers were given, the Security Printing Session focused on inkjet printing for secure documents. Structural color was a theme of the session.

Wednesday ended with a lovely Conference Reception held at Portland Art Museum, the oldest such museum in the Pacific Northwest area.

In addition to delicious food and lively conversation, attendees enjoyed viewing the museum's collection of paintings, photographs, and sculpture.

**Ink Substrate Interactions, Success Stories, and Tour Bring Conference to Conclusion**

It was gratifying to see the large number of attendees at the Innovative Applications, Ink Substrate Interactions, and Late-Breaking News/ Success Stories Sessions on the last day. Most of the presentations reported on exper-

iments that addressed substrate phenomena and interactions. One paper addressed the characteristics of paper that limit ink coalescence, resulting in single-dot features.

Another presented new evaluation method that compares adhesion without any processing of the specimen, rather than direct measurement of ink and substrate. This will be useful for investigators who need detailed results for this challenging measurement.

Werner Zapka (XaarJet AB) coordinated the annual Late Breaking News/ Success Stories Session. There was an unofficial and lively panel discussion of MEMS Ink Jet printheads, and the difficulty of de-inking for ink jet printing.

More than 40 attendees participated in the off-site tour of 3D Systems located in nearby Wilsonville, Oregon. The tour included a showroom and some facilities including the model shop.

Next year's conference—renamed Printing for Fabrication—will be held in Manchester, England from 12-16 of September. Please consider submitting a paper to this illustrious event. We look forward to seeing you there. ▲

32nd International Conference on Digital Printing Technologies (NIP)

**Printing for Fabrication**

*Materials, Applications, and Processes*

September 12 - 16, 2016  
Manchester, United Kingdom

**Abstract Deadline: March 15, 2016**

View the program via  
[www.imaging.org/archiving](http://www.imaging.org/archiving)

papers continued from page 1

### Separation of Granularity into Uniformity Deterioration Factors for Electrophotographic Images

Yumiko Kishi and Makoto Hino, Ricoh Company, Ltd. (Japan)

**Abstract:** It is important to not only evaluate granularity but also clarify the factors affecting it in order to improve the graininess of an image. A method for separating graininess into elements on the basis of the fluctuation of the background, lightness, and toner adherent area is proposed. By using this method following estimations will be enabled; 1. By obtaining the relation between the ordinary graininess and elements, the effect of each elements to the image quality can be estimated. This makes it possible to categorize printer. 2. Measuring by means of a polarizing plate, an effect of gloss ununiformity to the image quality can be detected. 3. By defining the standard contrast for a monochrome image, even though the dot density differs, the area fluctuation factor of graininess can be compared.

### Spot Color Matching for Digital Package Prototyping Using UV Ink-Jet Printer

Yu Ju Wu, Appalachian State University (USA), and Reem El Asaleh, Ryerson University (Canada)

**Abstract:** Digital printing technology is dramatically changing the packaging/prototyping market. Packaging work is among the most color critical in the industry. Matching corporate and brand colors is essential, as is the ability to accurately reproduce spot colors. The main purposes of this experimental study are to (1) examine the quality of spot color reproduction using UV wide-format inkjet printer for digital package prototyping, and (2) establish printing workflows for digital package production. In order to examine the spot color matching capability and establish a digital printing workflow for digital package prototyping, sets of

test samples were prepared. Spot colors from the Pantone color guide were used to design the spot color test chart for this study. CIE L\*a\*b\* values of Pantone color swatches were used as target values. Adobe Photoshop CC 2014 was employed to generate the spot color test chart in digital form. The designed test target was printed on different grade of paperboards and corrugated board on an EFI Vutek PV 200 UV inkjet printer. Color management with ICC profiles was used to investigate the reproduction of specific spot colors. These profiles were used to compare the device gamut and to investigate reproduction of specific spot colors. The quality of spot color matching was evaluated in terms of the  $\Delta E_{2000}$  in CIE L\*a\*b\* color space.

### Halftone Structure Analysis for Classifying Print Processes

Shankhya Debnath, Independent Researcher (India)

**Abstract:** Estimating the source of a printing process is of primary importance for investigative and forensic purposes. This paper deals with development and application of a method for identifying and broadly classifying the print process from a given print sample, especially official forms and certificates. The developed method was not limited only to electrophotographic (EP) method, but was extended to conventional printing methods like offset and gravure. Various methods were previously tested on EP printed samples, but its use on conventional printing methods are being presented for the first time in this paper. A number of features were extracted from the print samples collected, which includes the various halftone structural transformations that inherently becomes a part of the printing process. Also, the halftone dots that forms a part of the image in any printing process were analyzed using Hough transform and the features thus collected were used to form a reference database. The features in this database formed as inputs to a neural network classifier, whereby the classifier was trained to obtain outputs and classify them into EP, offset or gravure classes. Once the trained network was formed newer test print samples were used to extract the same features and fed into the network for classification. The results obtained clearly showed that the outputs were correctly recognized and hence the method presented is quite promising. ▲

## UPCOMING IS&T EVENTS

February 14 – 18, 2016; San Francisco, California  
Electronic Imaging 2016

April 19 – 22, 2016; Washington, DC  
Archiving 2016

September 12 – 16, 2016; Manchester, UK  
Printing for Fabrication  
32nd International Conference on Digital Printing Technologies

November 7 – 11, 2016; San Diego, CA  
24th Color and Imaging Conference (CIC24)

Learn more at [www.imaging.org/ist/conferences/](http://www.imaging.org/ist/conferences/).  
A complete list of imaging-related meetings is at  
[www.imaging.org/ist/conferences/events.cfm](http://www.imaging.org/ist/conferences/events.cfm)



**ARCHIVING 2016**  
April 19 - 22, 2016  
Washington, DC

View the program via  
[www.imaging.org/archiving](http://www.imaging.org/archiving)

# Standards News: Imaging and Graphic Arts

by Ann L. McCarthy, IS&T Standards Coordinator

## ISO Competition Law Guidelines

The ISO Council released *Competition Law Guidelines for Participants in the ISO Standards Development Process* in November 2015. The Guidelines address all meetings and exchange of information within the ISO standards development process and are relevant to all participants, including delegates, chairs, and secretaries of TCs and SCs as well as experts and conveners in WGs. These Guidelines are in addition to any competition law (also known as “anti-trust law”) guidelines and policies of member companies and organizations. Competition law applies to individual participants and to their sponsoring organizations. Compliance with competition law in the standard setting process is essential to ensure that the ISO standards development process remains a platform of trust for industries and hence continues to provide value as an enabling forum for markets and commerce. Early in 2016, the Guideline will be added to the standards developers resources at: [www.iso.org/iso/home/standards\\_development/resources-for-technical-work.htm](http://www.iso.org/iso/home/standards_development/resources-for-technical-work.htm)

## ISO/TC 42 Photography

### ISO/TC 42 November WG 18-20-23-25 Joint Meeting

TC 42/WG 18 currently has one recently approved NP: 20954-1, *Digital cameras — Measurement method for image stabilization performance — Part 1: Optical systems*, thirteen projects in development, and one recently published standard: *ISO 19084, Photography — Digital cameras — Chromatic displacement measurements*.

### ISO/TC 42 November WG 3-5-8 Joint Meeting

In addition to its current and new work, TC 42/WG 5 oversees a valuable set of standards covering imaging materials critical to archivists, as well as those still using traditional film and photographic paper. One of these, ISO 18927:2013 (Ed.3), *Imaging materials — Recordable compact disc systems — Method for estimating the life expectancy based on the effects of temperature and relative humidity*, has now been superseded by ISO 16963, *Information technology— Digitally recorded media for information interchange and storage — Test method for the estimation of lifetime of optical disks for long-term data storage*, recently published jointly by JWG 1 of JTC 1/SC 23 (Digitally Recorded Media for Information Interchange and Storage), ISO/TC 42, and ISO/TC 171/SC 1. The task group within WG 5 that previously dealt with optical disk topics has been disbanded.

### ISO/TC 42 Standards Working Groups and Projects

Work is progressing in TC 42/WG 18 on the working draft of ISO/PDTR 19247, *Photography — Guidelines for reliable testing*

*of digital still cameras*. WG 18 anticipates that these guidelines will fill a need among those conducting and publishing evaluations and comparisons of digital still cameras (DSCs) for commercial and industry applications. The guide will raise awareness of the prerequisites for reliable digital still camera testing such as test process fundamentals, interpretation of results, disclosure of measurement methods, and the mathematical analysis used in the test equipment.

TC 42/WG 18 standards in development cover diverse topics such as scene-referred workflow (ISO 17321-3), PhotoXMP (ISO 12234-3), ISO sensitivity (ISO 12232), noise measurement (minor revision of ISO 15739), electronic signatures (ISO 19920-1,-2), low light performance (ISO 19093), and battery life measurement (ISO 20087).

In TC 42/WG 5, the draft international standard is registered for the revision of ISO 18935:2005 (Ed.1), *Imaging materials — Colour images on paper prints — Determination of indoor water resistance of printed colour images*.

TC 42/WG 5 is working to simplify ISO 18937:2014 (Ed.1), *Imaging materials — Photographic reflection prints — Methods for measuring indoor light stability*. The ongoing worldwide evolution in lighting technology impacts the interior lighting that materials will be exposed to, and impacts the lighting components that are practically available in test fixtures. Work on Edition 2, to be a near term publication focused on Xenon test methods is underway. WG 5 anticipates that separate parts will be developed in the future for fluorescent lighting and LED lighting.

TC 42/WG 5 has resolved to address the complexities in the arena of ISO 18940, *Imaging materials — Reflection colour prints — Specifications for indoor stability*, which has been in development for some years, by adoption of the following structure: Part 1 will define the guiding principles for specifications and explain the overall framework, Part 2 will address consumer home, and Part 3 will contain the specifications for museum environments. Preliminary work items for Parts 1 and 3 will be registered shortly, with additional work in use case definition required prior to registering Part 2.

ISO/NP 21139-1, *Digital colour prints — Permanence and durability performance in commercial applications — Part 1: Definition of use cases and guiding principles for specifications*, has been initiated as a project of JWG 27, *Image permanence & durability test methods and specifications for digital prints in commercial applications*, a joint working group of ISO/TC 42, ISO/TC 130, and ISO/IEC JTC1/SC 28. The objective of this work is two-fold, to develop and recommend image permanence and durability test methods for digital color prints for commercial applications, and to provide guidance to users in understanding the

implications of test results for specific applications. Currently, there are no test permanence and durability methods available for digital color prints in commercial applications. As a consequence, a variety of test methods from other industries such as plastics, textile, paints & varnishes, lithographic printing and automotive are applied on ad-hoc basis. These test methods from other industries do not address the correct constraints and procedures for technically sound tests of digital prints using a range of substrates, colorants and layer materials. The multi-part ISO/NP 21139 project will be aligned with the objective image quality evaluation metrics currently under development by ISO/TC 130/JWG 14, another joint working group of ISO/TC 130 (WG 3), ISO/TC 42 (WG 5) and ISO/IEC JTC 1/SC 28 (WG 4).

TC 42/JWG 26 has published ISO 19262:2015 (Ed. 1), *Photography – Archiving Systems – Vocabulary*. This standard will be particularly useful to archivists as it pulls together terms relevant for imaging systems used for archival recording and approval.

TC 42/WG 8 has successfully moved ISO/DTS 20328, *Imaging materials — Lenticular lens sheet — Measurements and specifications of dimensions*, to publication. ISO/TS 20328 specifies measurements and specifications of dimensions of lenticular lens sheets, with measurement methods and nominal sizes and target dimensions with tolerances. This technical specification also describes methods to test the stability of dimensions of the lenticular lens sheet.

TC 42/WG 18 has approved registering ISO 19567-1, *Digital cameras — Texture reproduction measurements — Part 1: Frequency characteristics measurements using cyclic pattern*, for registration as a draft international standard. ISO 19567 overall specifies methods of measurement for digital camera capture and reproduction of low contrast fine detail, i.e., texture. Part 1 provides methods using test charts with cyclical patterns, which correspond well to the texture reproduction capabilities of most cameras. The long term trend in digital cameras to utilize small sensors with high pixel counts results in less light reaching individual pixels. With the signal getting smaller and the noise level remaining at a certain level, in-camera image processing typically reduces the noise after capture. The challenge for the algorithms in this area is to differentiate texture in the actual scene from the unwanted noise introduced by the capturing system. The ISO 19567 standard provides methods to investigate the achievement in this trade off.

TC 42/WG 3 has registered preliminary work items: ISO/PWI 20791, *Test targets for image quality measurements on small size photographic prints*, ISO/PWI 20792, *Characterization of physical aspects and print quality of photo books*, and ISO/PWI 20793, *Lenticular prints for changing images — Measurements of image quality*. ISO/PWI 20791 addresses the concern that the methods developed in ISO/TC 130 for the graphic technology area may not be suitable for the photographic industry. For example, tone modulation and the editing color space typically differ. Likewise, image quality assessments suitable for office and business applications may not be entirely suitable. Whereas TC 42/WG 5 has ongoing work for photo book permanence and

durability, the TC 42/WG 3 project, ISO/PWI 20792, will focus on ways to characterize physical book attributes such as thickness, stiffness, texture, and gloss in terms of interest to purchasers perusing books at online stores. In support of the lenticular print work in TC 42/WG 8, the TC 42/WG 3 project, ISO/PWI 20793, will assess image quality characteristics particular to lenticular prints, such as evaluation of optical cross talk and angular misalignment. Recommended practices for producing high quality lenticular prints will be included in an annex.

## ISO/TC 130 Graphic Technology

The scope of ISO/TC 130 Graphic Technology includes the standardization of terminology, test methods and specifications in the field of printing and graphic technology from the original provided to finished products. The scope includes, in particular, composition, reproduction, printing process, finishing, and the suitability of materials used in graphic technology. Printing is defined in ISO/TC 130 as a process of reproduction involving the transfer of a medium either colored or not to a substrate, using relief, planographic, intaglio, stencil or other image element.

## JOINT CGATS/USTAG/ IDEAlliance PPC Activities

Within the US, positions and contributions for ISO/TC 130 are coordinated through joint meetings of CGATS (Committee for Graphic Arts Technology Standards), the ISO/TC 130/US TAG, and the Print Properties & Colorimetrics (PPC) Committee, a working group of the IDEAlliance.

CGATS/GRACoL TR 006:2007, *Color characterization data for GRACoL® proofing and printing on US Grade 1 coated paper*, has been revised with minor changes to remove references to it being an "ANSI" technical report. The resulting TR006 has been balloted to CGATS/SC3 and approved and published. TR006 and other CGATS Technical Reports pertaining to graphics industry color and tone are available at: [www.npes.org/programs/standardsworkroom/toolsbestpractices/technicalreports.aspx](http://www.npes.org/programs/standardsworkroom/toolsbestpractices/technicalreports.aspx).

## ISO/TC 130 Standards in Development

In TC 130/JWG 8, the Edition 3 revision of the foundational ISO 13655, *Spectral measurement and colorimetric computation for graphic arts images*, is currently out for ballot as a draft international standard. ISO 13655 establishes procedures for the measurements and colorimetric computations appropriate to objects that reflect, transmit, or self-illuminate, including flat-panel displays. It also establishes procedures for computation of colorimetric parameters for graphic arts images. Key goals of the revision are to address the CIE Division 1 recommendations to improve the accuracy of the colorimetry (see ISO 11664-3), and to improve the specifications on the spectral nature of the backing materials. Both changes are expected to improve the inter-laboratory agreement of color measurement in graphic reproduction.

The TC 130/WG 2 project, ISO/DIS 17972-3, *Colour data exchange format (CxF/X) — Part 3: Output target data (CxF/X-3)*, is also currently out for ballot. ISO 17972-3 includes both for-

matting for the input of target recipe values and reporting of the measured result. In addition, ISO 17972-3 includes metadata to describe the layout of the targets. ISO 17972-3 is applicable for use with IT8.7/4. ISO 17972-3 defines a way to exchange the target data (recipe and measured values), essentially putting a CxF wrapper around the requirements for the original IT8 targets and also providing a way to state the format of the target by means of a custom resource that passes along data that shows the row and column arrangement of the targets. This defines a schema where data can be shared to avoid having different interpretations. Although the example is based on IT8 charts it is not restricted to these. In addition the standard will allow for the use of additional channels beyond CMYK.

TC130/WG 2 has agreed to structure ISO 20616 as a multi-part standard with the following parts: *Graphic technology — File format for quality control software and metadata — Part 1: Print requirements exchange (PRX)*, and *Graphic technology — File format for quality control and metadata — Part 2: Print quality exchange (PQX)*.

## CIE News CIE Publications

CIE 170-2:2015, *Fundamental Chromaticity Diagram with Physiological Axes — Part 2: Spectral Luminous Efficiency Functions and Chromaticity Diagrams*, aims to provide users with practical colorimetric tools, in the form of chromaticity diagrams. CIE Technical Committee TC 1-36 was established to work on a fundamental chromaticity diagram of which the coordinates correspond to physiologically significant axes. .

Part 1 of the report, published in CIE 170-1, *Fundamental*

*Chromaticity Diagram with Physiological Axes — Part 1: Definition of CIE 2006 Cone Fundamentals*, was limited to the choice of a set of colour-matching functions (CMFs) and estimates of cone fundamentals for the normal observer, ranging in visual angle (field size) from 1° to 10°.

Now Part 2 includes the definition of cone-fundamental-based spectral luminous efficiency functions as a linear combination of the long-wave sensitive and the middle-wave sensitive cone fundamentals, following the proposal of Sharpe et al. Cone-fundamental-based spectral luminous efficiency functions are proposed for the 2° and for the 10° photometric observers. In addition, to allow for comparisons with the traditional CIE procedures, transformations of the cone fundamentals in the form of cone-fundamental-based XF, YF, ZF tristimulus values and xF, yF chromaticity coordinates are presented. The linear transformations that should be used to compute the XF, YF, ZF tristimulus values from the cone fundamentals are given with the number of decimal places necessary to produce spectral tristimulus values with 7 significant figures. The report ends with tables and references and all tables are downloadable via a link in the document.

## CIE 2016 Lighting Quality and Energy Efficiency Conference

CIE will host the fourth biennial CIE Lighting Quality and Energy Efficiency Conference, the previous three having been held in Kuala Lumpur (2014), Hangzhou (2012) and Vienna (2010). We invite you to join over 300 delegates from all parts of the globe to attend the conference. The conference will take place March 3-5, 2016 in Melbourne, Australia. Conference topics include: quality lighting and energy efficiency, interior and exterior applications, light and vision, photobiological effects, and photometry and measurements. Details are available at: <http://melbourne2016.cie.co.at/home>. Meanwhile the CIE Central Bureau will be delighted to answer any questions that you might have at: [ciecb@cie.co.at](mailto:ciecb@cie.co.at).

CIE Division meetings will be co-located with the conference, and will be held March 7-9, 2016. The following CIE Divisions will meet in Melbourne:

- Division 1: Vision and Colour — Technical Committee meetings only.
- Division 2: Physical Measurement of Light and Radiation — Annual Meeting and Technical Committee meetings.
- Division 4: Lighting and Signaling for Transport — Annual Meeting and Technical Committee meetings.

*Experts are welcome to contribute to ISO standards development through their corresponding national committees. Additional information on photography standards is available from the ISO/TC 42 Secretariat, [isotc42@ansi.org](mailto:isotc42@ansi.org). Additional information on graphic technology standards is available from the ISO/TC 130 Secretariat, [tc170\\_cyc@126.com](mailto:tc170_cyc@126.com).*

*For questions about the activities of TC 42, for suggestions for (or input to) future updates, or standards questions in general, please contact the IS&T Standards Coordinator at [standards@imaging.org](mailto:standards@imaging.org).*

## IS&T REPORTER

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